Engineering
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Engineering News-Record

Devoted to Civil Engineering and Contracting
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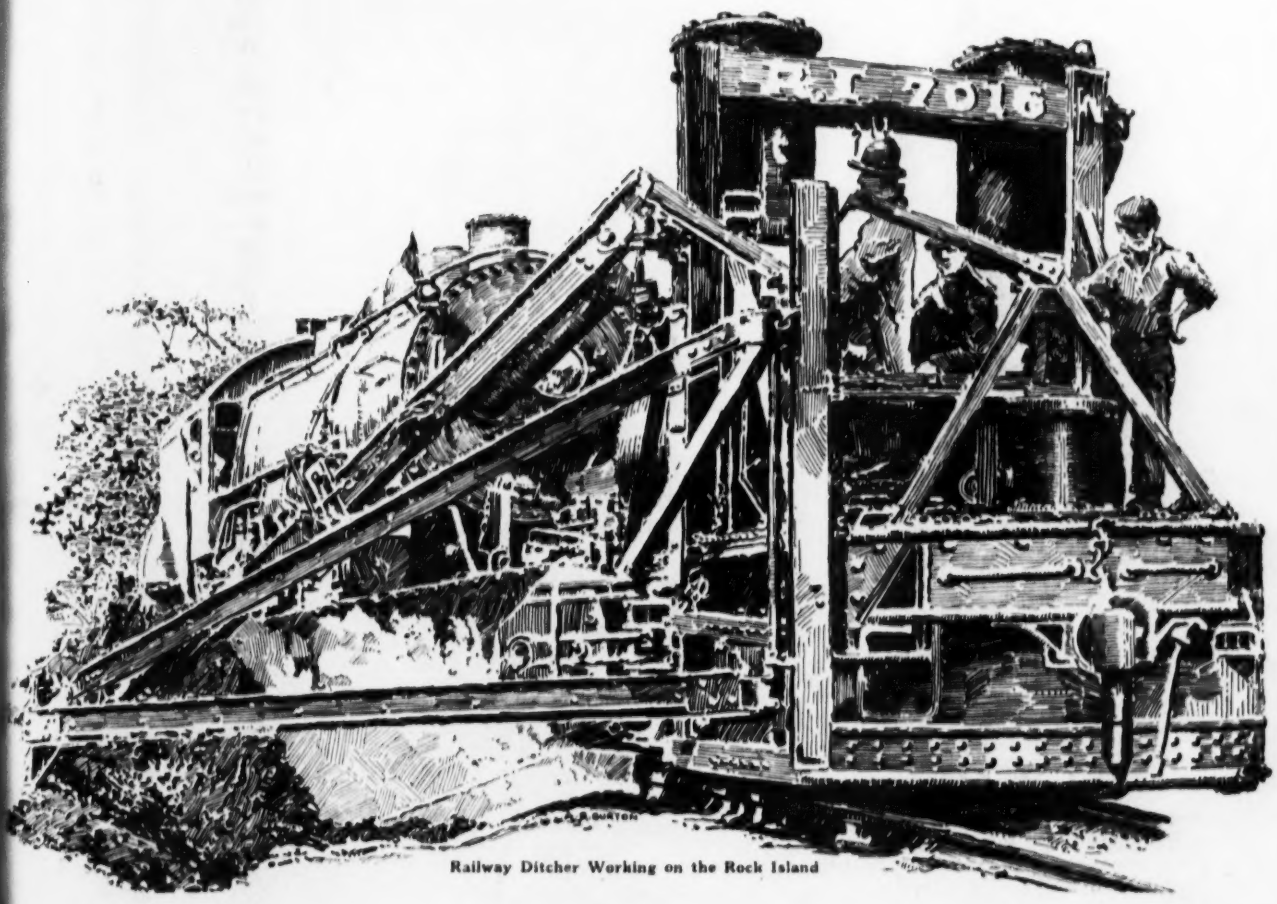


Railway Ditcher Working on the Rock Island

For the Railway Engineer and Contractor

Track Maintenance by Contract on the Canadian Pacific R.R., *by H. G. Horton*

Maintenance in 1921 Failed to Meet Railway Needs, *by Julius H. Parmelee*

Railway Ditching Machines Typical Practice on Two Railroads

Driving a 5-Mile Rock Tunnel for a Japanese Railway

New Division Terminal on Pere Marquette Illustrative of Current Good Practice

General Motors Trucks

Hauls 17,000 Tons of Road Materials Without One Moment's Delay on Job

Recently the Mississippi Lime and Material Company, Alton, Illinois, accepted a contract to supply all the crushed stone, sand and cement for a road building job on which the time limit set for completion was very short.

Although the mixers used on this job by the contractor were located seven miles away and in spite of the fact that each load had to be hauled over considerable hilly country and rough roads, this company delivered 17,000 tons of material with their five GMC trucks without even as much as five minutes delay during the entire job. Every load arrived at the mixers precisely as scheduled.

Contractor Well Pleased

In commenting afterwards, the road building contractor declared emphatically that his profits from this job were entirely the result of the excellent service rendered by the Mississippi Lime and Material Company and their fleet of GMC trucks.

Three of the GMC trucks owned by this company were purchased in 1916, the other two were added the next year; they are all equipped with dump bodies. A series of overhead hoppers built by the company facilitate the loading of their materials.

In speaking of the splendid performance of their trucks this company states that after all these years of hard, continuous usage the trucks are providing just as satisfactory and economical service as when they were new.

Accessibility Important

Like other experienced motor truck buyers, the Mississippi Lime and Material Company selected GMC trucks because they were looking for more than the unquestioned evidence of skilled engineering and precise manufacture. They realized that in no other line of work is a truck subjected to such gruelling tests, day after day, as in their business. They appreciated, too, that mechanical accessibility is equally important to economical, uninterrupted service.

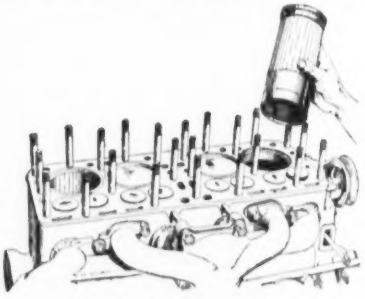
A truck which must be laid up for perhaps days, with lost revenue and several hundred dollars' worth of labor expended to replace or readjust a minor part, is an expensive proposition to own, regardless of how well it operates.

The GMC engine was designed exclusively for motor truck usage with full appreciation of all the essential qualities necessary for the success of such an engine under all conditions—economy of operation—surplus power—and quick accessibility for readjustment and replacement, with the consequential lowered costs for this work.

Removable Cylinder Sleeves

It is possible to remove a cylinder sleeve from a GMC engine and replace it in a few hours without having to go to the great expense of tearing down the engine, as in the case of the common type of motor.

Each cylinder in a GMC engine is a separate sleeve which is pressed into place in the cylinder block. This is a new type of cylinder construction that not only adds to the efficiency of the engine's operation, but also is most economical in cases of damaged cylinder walls.



Removing GMC Cylinder Sleeve.

The sleeves are machined on both sides to accurate thickness and the expansion and contraction of the walls under temperature changes, is consequently spread evenly, preventing the cylinder from becoming out of round and causing excessive wear.

Moreover, this type of cylinder construction insures an absolute and continuous fit of piston rings and pistons, preventing any loss of compression as is the case of the common type of engine when cylinders become out of round.

Send for a copy of our special truck book. It's yours for the asking.

GENERAL MOTORS TRUCK COMPANY

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

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Concerning This Issue

NEXT week the American Railway Engineering Association will open its annual meeting in Chicago. It is appropriate, therefore, that in this issue *Engineering News-Record* should turn to a consideration of railroad problems in so far as they are the concern of engineers. Of such problems the foremost is doubtless that of maintaining a safe and adequate transportation machine. A little later, perhaps, railroad men will be required to take up again the more stimulating work of expansion and new construction; but just now the task is maintenance. The serious character of this problem will be appreciated after a consideration of Mr. Parmelee's review of 1921 maintenance work, while an indication of the lines along which it has been attacked is contained in the article on machine-ditching and in the description of the maintenance-by-contract system that has been used by the Canadian Pacific Railway. In the first case economies are effected by the substitution of machine for hand labor, while in the latter the end is sought by dealing more efficiently with the human element. The article on the reconstruction of French railway structures suggests something of the resourcefulness that French engineers have brought to bear on a tremendous and disheartening task; while the story of the 5-mile tunnel on the Tokyo-Kobe railway may be something of a surprise to those who think of Japan as a land of miniatures. Let us hope that a year hence we may be able to chronicle the beginnings of new railroad undertakings, now long overdue, and worthy of the best engineering talent that America can bring to their service.

Good Work by the F. A. E. S.

THE reorganization of the Patent Office so long demanded by engineers is now a fact. The President has signed the bill reclassifying the examiners and guaranteeing salaries that approach the value of the services rendered; at least they are sufficient to issue retaining capable men for a fair length of time. Credit must be given the Federated American Engineering Societies for their persistent campaign in favor of this bill and for their part, a large one, in the final success.

An Economic Touchstone

ROBBING Peter to pay Paul has always been a favorite form of economic readjustment, both in private and public affairs. Just now it is especially popular at Washington, where conflicting interests, each looking for its own salvation, are playing on the average congressman's desire for re-election. Economic nostrums to bring about the long-awaited return to normalcy, either individual, group or national, are seriously put forward every week, and unless the people, by individual expression and through the press, make known their wishes so strongly that Congress cannot misunderstand, some, at least, of this special interest legislation is going through. The average citizen, honestly looking for his own benefit through benefiting the whole country, may be somewhat at a loss as to what stand he should take on any particular proposal. For such a man the editor of "The World's Work" advances a pretty good touchstone. Of the various measures before Congress, he says "If it proposes to give somebody something, it is bad. If it proposes to buy something for which there is no market, it is bad. It it proposes to tax one class of people or one kind of business, for the purpose of benefiting another class of people or another kind of business, it is bad." In other words, transferring money from one pocket to the other never boosted a credit rating.

Speed Up Departmental Reform

NEARLY a year has gone by since the President appointed the Brown commission to report on a reorganization of the government departments for better efficiency. It is reported that the commission has made its recommendations and that they will be soon submitted to Congress by the President. Unfortunately, if things are allowed to take their normal course, there is much less chance of anything useful or definite being done now than there would have been a year ago when the Administration heads were new to the departmental game and not infected with the bureau pride that so soon gets in its deadly work. Aroused public opinion is needed to renew the effort to put more business in government. To the office man in Washington whatever is is right. A proposal for a change is an invasion of vested rights. Working, as most of them do, for less pecuniary reward than could be won in business fields, they seek compensation in power and they fear any readjustment of functions as a reduction of that power. With a new group of head officials, fresh from business life and with an unprejudiced desire to improve government service by more efficient organization, there were prospects that these existing influences might be overruled. The new officials are fast becoming old government employees and their enthusiasm for a proper rearrangement of the federal bureaus needs the reviving influence of the citizen, who is still looking at government objectively. Societies and individuals should continue their efforts to put the departmental reorganization through.

Local Motor-Truck Restrictions

ENACTMENT or amendment of state laws is generally such a slow process that certain counties, actuated by a desire to protect their highways from damage by motor-truck traffic, have taken the initiative in passing local regulations restricting gross weights of vehicles. While such action has justification in certain cases as an emergency measure, it is attended with manifest disadvantages. County regulation, of

course has the advantage of providing immediate relief because authority is vested in existing agencies which can protect the investment of county taxpayers in good roads from being wiped out by unreasonable traffic. Nevertheless, if the practice of county regulation of motor vehicles becomes general, the already unsatisfactory condition of traffic legislation by state laws will become chaotic. Even where the states undertake to fix license fees and limit loads, there is the greatest lack of uniformity. This is the condition where forty-eight agencies have a finger in the pie. Increase this number of agencies to many thousands and the result becomes appalling. At certain seasons of the year, particularly in the early spring when the roads are soft, reduction in the normal allowable gross weight is highly desirable and, in fact, a number of the states have passed laws empowering the state highway engineer to impose such temporary restrictions as emergency measures. This sort of seasonal and, in some cases, local regulation is an entirely different matter from that of regulation by such political units as counties. Trouble experienced in protecting highways from excessively heavy vehicular loads is due, in many cases, not to lack of legislation but to laxity in measures of enforcement of existing laws. An investment in loadometers and a few platform scales has been found, in many localities, to be an effective antidote for the overloaded-truck evil. Before counties resort to independent regulation they should experiment for a few weeks, at least, with rigid enforcement of the existing state law.

"Remedies" that Destroy

"DISTORTED" railway rates, as Secretary Hoover calls them, have a much more vital significance to the public than merely to effect a temporary change in the prices of commodities. They produce a distortion of the entire economic structure that is far-reaching in its scope and appallingly wasteful in its effect.

Let us for a moment examine the commercial structure. It may be likened roughly to an open-meshed fabric composed of many strands woven hither and yon, each under a certain stress and each elastic to some degree. Where they cross, these strands are not bound tightly; nevertheless they do tend to concentrate their crossings at certain foci where they adhere more or less.

These strands represent the commercial influences and facilities. Some of them are material, as railway, highway, and water-borne traffic. Some are quite intangible, as credit, railway rates, foreign competition, and the buying habits of the people. At the foci, where the strands cross, are the centers of commerce, production, and population.

So long as commercial conditions are normal, this vast and complicated fabric is in equilibrium, each strand giving a little and taking a little under the slight distortions of changing commercial conditions. A drought in Kansas, a minor change in freight rates in New England, or a bank failure in Texas, may disurb the equilibrium more or less, producing stresses in the strands. These, however, are well within the elastic limit and although the fabric changes shape slightly, it remains intact.

But under violent or far-reaching disturbance this no longer is true. Under such stress some strands are strained almost to breaking, others snap, while still others may be wholly relieved of stress and thrown out of action. New foci are created by the shifting and readjustment of the strands amongst themselves; great investments of capital at existing foci and along certain of the strands may be rendered useless and, for all practical purposes, destroyed. The San Francisco fire was such a disturbance. Let those who doubt ask Seattle and Los Angeles. The opening of the Panama Canal was another, although its effects were, so far as possible, discounted. Hill's steamship lines to the Orient were still another.

But all these were trifling alongside the disturbance that was inflicted upon the fabric by the horizontal increases in railroad rates. As Secretary Hoover has pointed out, these were imposed broadcast without regard to existing conditions. The increased rates since 1914 he tells us have added probably less than 1 per cent to the price of cotton goods while they have added nearly 100 per cent to the cost of assembling the materials for pig iron.

"All this," continues the Secretary, "is artificially forcing our industries to move toward their raw materials. This does not alone represent the starting of a new factory; it is a movement of the whole mechanism of the community, labor, homes, schools, railways and what not—an enormous duplication of plant and loss of capital. We will ultimately have the rates readjusted and then we will destroy the new industries created under them."

What Secretary Hoover points out with respect to railway rates applies with equal force to every sweeping and undiscriminating change in the commercial fabric. His words should be pondered by the panacea-hawkers who infest the land, directing their efforts toward attainment of a single object and forgetting that no fundamental can be changed without affecting the entire structure.

The Maintenance Man's Burden

ALMOST everyone will agree that full benefit cannot be realized from a business revival unless the railroads are in shape to meet the needs of expanding business. Everyone will agree also that the railroads are far from being in such shape today. If there be doubters we refer them to Mr. Parmelee's review, elsewhere in this issue, of 1921 maintenance, and to his conclusion that "maintenance during 1921 was not sufficient to make good the deterioration of the plant during that year, either on the basis of normal traffic or on the basis of the decreased traffic actually handled."

Just what does this mean? It means, in the first place, that in default of adequate appropriations the burden of keeping our railroads going has borne heavily on those executives and engineers who have been responsible for the maintenance of way, structures, and rolling stock. It means that these men have been required to make bricks without straw, and to their credit be it said that they have succeeded admirably. We are prone to hail the builder of a Woolworth Tower or a Panama Canal and to overlook the achievement of the engineer, who, day in and day out, in the face of most adverse and disheartening conditions continues to hold his plant up to operating requirements. But despite the splendid page that these men have written in American engineering history, the fact remains that railroad properties have deteriorated sadly; and if they are to perform the service that will be demanded of them by a business

revival they should be re-established as safe and adequate transportation machines having a reasonable operating factor of safety.

This means money. Where is it to come from? We can figure on no increase in gross earnings from a general increase in rates. Possibly a few dollars may be scraped up from rates here and there, but the possibility is slim. To meet immediate needs we must continue to look to economies in operation as the principal source of revenue.

Incidentally, let us point out in passing that the scamping of maintenance is not economy. To let a property deteriorate does not save expense; it consumes capital. In desperate straits, a man may be forced to draw on his principal, but we should scarcely call such a course an "economy." True economy must be sought elsewhere. Frills may be eliminated; brains may be substituted for brawn; machinery may replace manual labor. In some departments progress has been made in reducing the restrictive influence of labor unions, but along this line there is still opportunity to get more nearly the worth of 100 cents for each dollar of wages paid. These are true economies as opposed to the false economy of inadequate maintenance.

But all that may be saved by these methods does not begin to approach the need for new construction and equipment. We are told, therefore, that from the first slim earnings of the hoped-for revival we must begin to wring dividends which will re-establish the credit of the roads and permit the financing of the more far-reaching improvements. Such a course we believe would be most unfortunate. When the revival comes, deferred maintenance should have a lien on earnings senior to any dividends or rate-cuts, except possibly cuts on primary commodities which might be expected to stimulate a worth-while volume of earnings.

That is one reason why we have looked with favor on the proposal of Secretary Hoover that government credit —not cash—be loaned to the railroads for this purpose. In this way, and in this way only, can the railroads be assured of the capital they need at a reasonable interest rate without being compelled to create a false appearance of prosperity by diverting their earnings from the maintenance that is so essential.

Industrial Relations Court to the Bar

TWO YEARS ago Kansas embarked upon an industrial experiment best known as the Industrial Relations Court. By many employers the court was regarded as a new form of anti-strike or anti-picketing measure and hailed accordingly. Organized labor appeared to agree with these employers for its leaders soon set out to oppose the new agency of government. No less a person than Samuel Gompers locked horns in public debate with Governor Allen, chief proponent of the court. Labor, we are told, dubbed the new law "The Kansas Slave Act."

But times have changed. The economic whip has passed from the hand of labor to that of management and with the passing matters have assumed a different aspect. An association of employers has now set out to "get" the court. Legal action has been brought by one of them, and plans are now hatching to make the court a leading issue in the fall political campaign. Management, we are told, fears that government has gone farther than it should and sees in the court a tendency to exercise a "paternalistic and managerial jurisdiction" over private industries.

Maybe so. As with most experiments, this effort may have failed to score a hit on its first shot; but if we can judge by the reactions of labor and of management the court seems to have its target fairly bracketed.

Whatever turn the controversy may take, however, it is to be hoped that the people of Kansas will not forget the standard broken out by Governor Allen when he undertook the championship of the Industrial Court measure; viz., that it is a duty of government to protect the people it serves against the evils of industrial warfare no less than against those of external aggression. The Industrial Court, to be successful, must be nobody's weapon; it must be a shield to protect the bystanding public equally against the stray bullets of labor or of management. At this distance we cannot say whether it has done this. Its friends say that it has succeeded splendidly and that since its establishment strikes have been almost eliminated and many radical agitators have left the state. Its enemies, on the other hand, pronounce it a complete failure. They say that it has provoked strife rather than prevented it and that it has driven desirable industries away from the state.

These are questions of fact which the people of Kansas should be in position to answer. Two years may be too short time in which to determine finally the precise agency that will best carry out the idea behind the Industrial Court but surely it is long enough to demonstrate whether the present tribunal is headed in the right direction.

Studying Construction Methods

IMPORTANT work in studying construction equipment and methods will be undertaken this year by the Associated General Contractors. The success of this work will depend very largely upon the co-operation which contractors give the agents of the association whose task it will be to assemble the information. These men can, from their own experience, furnish only a small number of the facts which will be necessary as a basis for conclusions.

Information must be made available from all sections of the country so that variations due to climate, labor conditions, character of soil and the scores of other differences in conditions can be appraised and averaged. This means that contractors widely must contribute liberally from their records. As individual methods and costs will probably in no case be made public, the information given can be complete and candid without fear that business secrets may be revealed. Indeed, the information must be full and frank or the conclusions will be false.

That the contracting industry should determine preferred practices in equipping construction work and preferred methods of doing work does not admit of argument. Bidding prices will be stabilized, average quality of construction will be improved, but most important of all, the standing of the contractor as an expert in construction will be strengthened in the opinion of engineers and owners.

It may even be possible in some measure to approach standards. Obviously, however, standardization has to be attempted with caution. Nothing must be done that will discourage improvement in equipment and methods. Standardization may wisely be left until later.

Railway Ditching Machines and Performance Records

Wing Type Ditchers Clear Track Ditches and Dress Slopes Rapidly and Cheaply—Comparative Costs of Hand, Team and Machine Work

THE substitution of machinery for manual labor in cleaning track ditches and widening cuts has accomplished so much for improvement and economy in maintenance of way work that as a result of present labor conditions it is being considerably extended.

Ditch cleaning by hand is slow, heavy and tedious work, and on a large portion of the track mileage it cannot be handled properly by the section gangs along with their many other duties. Work trains and extra gangs must, therefore, be assigned for periodical ditch cleaning, such trains to include one or more ditching machines or to be manned by a large gang of laborers.

Railway ditching machines are of two general classes. The first, or wing type, consists of a heavy car fitted with a side wing or scraper blade shaped to conform to the standard section of the ditch and roadbed shoulder. This wing cuts the soil and pushes it ahead to some point beyond the cut where it can be thrown

FIG. 1. DITCHING MACHINE OF WING TYPE ON ILLINOIS CENTRAL R.R.

clear of the roadbed. A modification of this type has, instead of a wing, a scoop or bucket hung from a derrick at the side of the car. The wings or buckets, as the case may be, are handled by power equipment on the car, usually operated by compressed air from the locomotive that pushes the car. In general, the ditching is done on one side at a time, but the larger machines have wings on both sides and can clean both ditches at once. In addition to cleaning ditches these machines can also be used advantageously to cut down the shoulders on fills, thus improving drainage without disturbing the ballast shoulder.

The wing type of railway ditcher is a development of the spreader car so extensively used for leveling material dumped or plowed from cars, and several companies manufacture ditching wings that can be attached to spreader cars.

The second type of railway ditcher consists of a small revolving steam shovel mounted on a length of track on the deck of a flat car. Ordinarily the shovel travels along a train of such cars, loading the excavated material behind it. On double track, two work trains are sometimes employed, the ditcher occupying one track while loading a train on the other track. When a work train cannot be allowed to occupy track for any length of time, the car carrying the steam shovel may be attached to a dump car or placed between two dump cars. By quick movements between its working point and a sidetrack this train can keep clear of traffic (see *Engineering News*, March 16, 1916, p. 498).

For ordinary ditching in earth and soft soil on the Illinois Central R.R. a machine of the wing or scraper type is employed, as shown in Fig. 1. If the excavation is heavy or in hard soil and includes the widening of cuts, it is often found desirable to handle the bulk of the excavation with dump or wheel scrapers and teams, or a ditcher of the steam shovel type, using the scraper machine to finish the ditch to the grade of the standard roadbed section. The cost of the steam-shovel work has been found to be greater than that of cleaning by the scraper or wing machine. In general, however, once

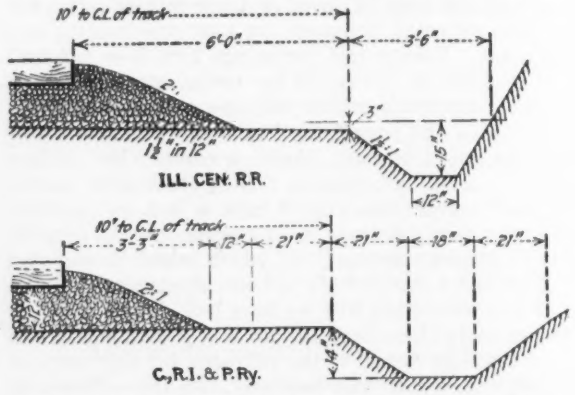


FIG. 2. DITCH AND ROADBED SECTIONS FORMED BY MACHINE

the cuts have been restored to the standard section, the ordinary cleaning of ditches involved in regular spring or fall maintenance work can be done entirely by machines of the wing type.

In operation, the wing ditching machine is pushed through the cut, the wing being adjusted to suit the conditions. As a rule, one or two runs are made, but in some cases as many as five runs are required to cut to the desired depth and width. On the last run a steel template on the bottom of the wing finishes the roadbed shoulder, ditch and side-slope to the standard section, shown in Fig. 2. In the heaviest work the machine can push ahead of the wing about 10 cu.yd. of material which is carried beyond the cut far enough only to throw it over a fill or to spread it. An average day's work is about 400 cu.yd. of material moved and about 4,700 ft. of ditch finished. Several different features of machine ditching work are shown in Fig. 3.

For the best results, a heavy locomotive is used, operated at a speed of from 3 to 10 miles per hour, according to the character and amount of material and the condition of the track. The greatest efficiency is obtained with two wings, since the second wing eliminates much

back haul of the machine. Occasionally both wings can be used at the same time, giving a balanced load which permits a greater speed with safety. The crew consists of an engineman and fireman on the locomotive and one or two men on the ditcher to adjust the wings, the second man being necessary only when two wings are operated at the same time. There is required also the usual number of trainmen. The engine and ditcher constitute a work train which is handled under the usual work-train orders from the dispatcher and which is run to the nearest siding to clear traffic.

It has sometimes been found necessary and economical to ditch certain rock cuts, sliding cuts and tunnels by means other than work trains and ditchers. In such places, push cars have been used, with dump boxes designed for quick unloading. Pony cars, somewhat similar to a track barrow, and running along one rail, have also been used to advantage, especially in rock cuts where work-train service would be costly because of very heavy traffic. A special method of this sort was used by the Illinois Central R.R. to ditch in Head's Cut, Indiana, which gave so much trouble from sliding that day and night watchmen were necessary to protect traffic. A narrow-gage railroad with very light rail was laid between the track and the side of the cut to carry small tram cars. By this means two men have been enabled to keep this cut well ditched.

Machine work is so much more economical that work-train ditching with hand labor is no longer done on this road, except where no other means will serve. For such hand work as is necessary a train of flat cars with low side boards is ordinarily used. This is loaded by a gang of from 40 to 100 men and unloaded on an adjacent fill by means of a rapid-unloader. This consists of a plow that is pulled through the cars by a cable wound on a hoisting engine set on a car next to the locomotive. It is estimated that even under conditions favorable to hand work, a wing ditching machine can do twice as much work in a day as can be done by a gang of 100 men.

Where ditchers of the small revolving steam shovel type are used on this railroad they are practically always operated in pairs, the outfit consisting of two ditchers, each located between two 20-yd. air dump cars. These, with the locomotive and caboose, constitute the work train. With machines of the revolving steam shovel type and the wing ditcher type available the amount of ditching by hand, team or other methods has been greatly reduced. In fact, it is expected that such methods can ultimately be eliminated except for a few cuts where conditions will not permit the use of either type of machine.

No one method of clearing ditches is the most economical or practicable for all conditions on a large railway system. Comparative costs of different methods were given in *Engineering News-Record* of Oct. 9, 1919, p. 700. According to an investigation made on the Illinois Central R.R. the several methods may be compared as follows:

1. The spreader or wing ditcher with ditch-shaping attachment is best for cuts where the material can be pushed through. The work done in this way would cost 10c. to 30c. per cubic yard in places where by any other method it would cost 24c. to 75c.

2. The steam-shovel ditcher with flat cars and unloader plow can be employed to advantage in long cuts where the traffic is light and the haul to dumping point is long. This work would cost from 40c. to $1 per yard in locations where the cost by any other method would be 50 per cent greater.

3. The same type of ditcher used in pairs with dump cars, as described, is in general the most economical method for use in long cuts where teams cannot be used and where the haul is too great for other methods. In such cases the cost would be 20c. to 50c. per yard, where by other methods it would be 50c. to $1.50.

4. Teams may be used where the wing type of ditcher is not available for cuts not more than 600 ft. long or with places where teams can take the earth to the top of the cut. The cost will be from 30c. to 75c. per yard.

5. Men handling push cars and dump trays can be

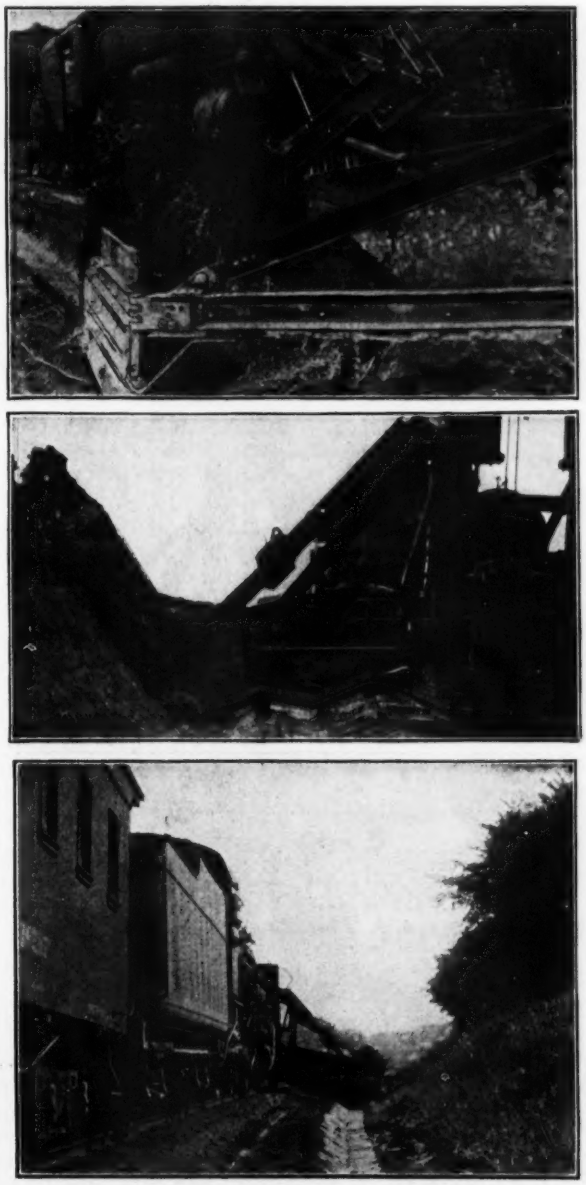


FIG. 3. DITCHING WITH WING MACHINES ON THE ILLINOIS CENTRAL R.R.

A—Main and auxiliary wings form pocket for heavy dragging. B—Finishing the ditch and shoulder to standard section. C—Ditching train at work.

used to advantage on lines of light traffic with relatively short cuts which are too narrow for other methods or in short deep cut where teams or wing ditchers are not available.

6. A ditcher plow may be used in prairie country with very light ditches, and for light work in shallow cuts where a wing ditcher is not available. The cost would be from 10c. to 30c. per yard.

7. Narrow-gage tracks and monorail cars may be economical in cuts where material is sliding or falling continually and where watchmen must be maintained.

A ditching machine of the wing type has been used extensively on the Iowa division of the Chicago, Rock Island & Pacific Ry., principally in shallow cuts, some of which are 1,200 ft. long. Various kinds of material are encountered, ranging from gravel to earth and wet

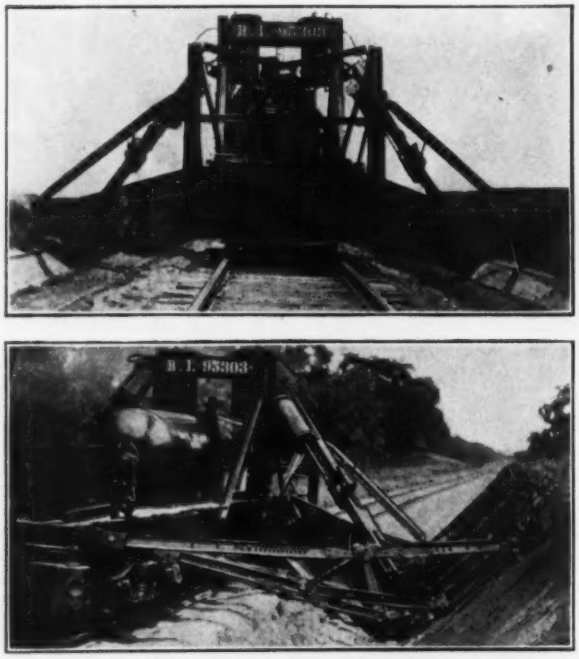


FIG. 4. WING TYPE DITCHER ON THE ROCK ISLAND LINES

Above—Wings extended to cut both ditches at once. Below—Auxiliary wing in position to widen cut.

clay. In order to cut the ditches and dress them to standard section several trips are necessary through the longer cuts. In one 1,200-ft. cut it was necessary to make 36 runs, removing 166 cu.yd. of material. In this work, the 45-ton ditcher is handled by a heavy 2-8-2 engine at a speed of about 6 m.p.h., ditching on either one or both sides of the track as required. The train requires only the train crew and one operator on the ditcher. In operation, the ditching train involves little delay to traffic, since the ditcher wings can be folded back in one minute while the train is moving into a side track.

These machines not only decrease the cost of the work but also make possible a more extensive ditching program. For these reasons it is planned to increase their use, supplanting the hand shoveling and team scraper work so far as possible, except at some places where it may be impracticable to work the machines. Ditchers cleaning both ditches simultaneously and widening one side of a cut are shown in Fig. 4.

According to figures given in the January number of the *Rock Island Magazine*, the expenditure for ditching on this railroad for the past six years have averaged $900,000 and the unit costs have been reduced to a remarkable extent by the introduction of ditching machines of the wing or scraper type. During two months' work in 1921, two wing machines moved 29,000 and

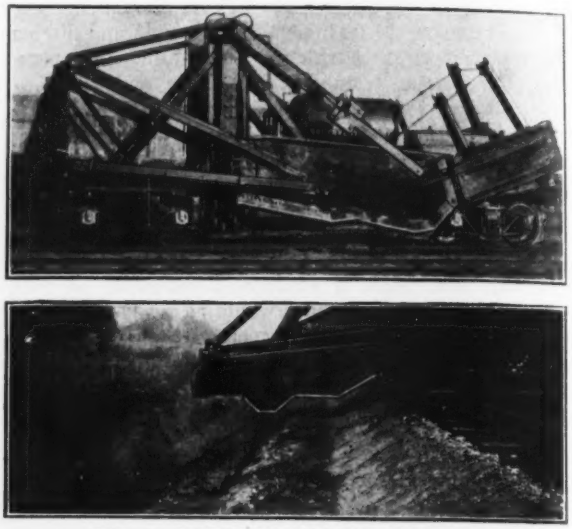


FIG. 5. RAILWAY DITCHING MACHINE

Above—Wings folded for transportation. Below—Wing templet to cut ditch and shoulder.

28,000 cu.yd. at a labor cost of 1.33c. and 1.8c. per yard respectively. Two machines of the steam shovel type, operating largely in heavy cuts, moved in one month 7,000 yd. each at a labor cost of 21.8 and 23.5 per yard. From figures of 1920 and 1921, the comparative labor costs for four methods were estimated as follows: Hand ditching, 75c. per yard; teams with scrapers, 40c.; shovel ditcher, 24c. wing ditcher, 1.5c.

The wing type of railway ditching machine used on the work described above consists of a 40-ft. steel flat car with a plow or pilot across its front end fitted with cast-steel cutting shoes, to clear the track of material in front of the machine. This plow is raised and lowered by an air cylinder on the floor of the car. Above the floor and at the rear of the front truck is a steel upright cross frame supporting the vertical air cylinders for operating the main wings, which are on either side or both sides of the car. The wing, made of heavy plate, is approximately 5 ft. deep and 15 ft. long, having its lower edge protected with manganese-steel castings and shaped to cut the standard roadbed and ditch section of the railroad using the machine (see Fig. 2). The ditcher with wings folded for transportation and with one wing extended to show the templet, is shown in Fig. 5.

At the outer end of this templet or main wing is pivoted another wing which can be set and held at any desired vertical angle. This auxiliary wing can also be swung forward on a vertical hinge so that it is nearly parallel with the track, its forward end being then connected with a supporting steel frame on the forward end of the car. In this position when the main wing is swung out to its working position, the two wings form a pocket. This arrangement of the wings is used in dragging material from a heavy cut, as shown in Fig. 3 (A), thus leaving a clean ditch shaped to the standard section.

Heavy structural steel braces from the sides of the

car hold the wings in their working position. These braces are adjustable in length to suit the required horizontal angle of the wing, and are jointed at the middle so as to fold up when the wing is swung back against the car in position for transportation. An inclined tie, pivoted to the top of the upright frame on the car, is attached to the outer tip of the wing and is fitted with a pneumatic cylinder for varying the inclination of the wing. Air cylinders suspended from the frame of the car move the wings in and out.

COST RECORDS BY RAILROAD DITCHING BY WING MACHINES: 1921

Railroad	No. Ft. Ditched In Open	No. Ft. Ditched In Cut	Average Haul	Total Ft Ditched	Total Cu.Yd. Moved	Total Cost	Cents Per Ft. Ditch	Cents Per Cu.Yd.
H. & T. C....		924	500	924	150*	$116.05		
H. & T. C....		6,818	500	6,818	1,278	121.11	1.7	9.5
L. & A.†.....		4,928		4,928		88.70	1.8	
L. & A.†.....	6,688	2,992		9,680		97.59	1.0	
L. & A.†.....	36,608			36,608		98.28	0.2	
L. & A.†.....	23,056			23,056		99.65	0.4	
L. & A.†.....	19,712			19,712		96.23	0.5	
L. & A.†.....	15,136			15,136		92.12	0.6	
H. & T. C....	9,140			9,140	1,525	107.00	1.1	7.0
C., R. I. & P..	307,560			307,560		467.64	0.15	
A. & G. W....		1,870	900	1,870	1,402	112.60	6.0	8.0
F. W. & D. C..	27,600			27,600	29,875	108.34	0.4	0.4
F. W. & D. C..	29,600			29,600	34,933	108.34	0.3	0.3
M. K. & T....	116,425			116,425		619.88	0.5	
				609,057		2,333.53		
Average cost per foot of ditch.....							0.38	

*In addition to the 150 cu.yd. for ditch on the H. & T. C. R. R., a hard clay ridge, extending along the right of way for 15,345 ft. was spread below the ballast level; 4,070 cu.yd.

†On the L. & A. R. R. no record of yardage was kept. Between Nov. 30, 1920, and March 1, 1921, this railroad completed 200 miles of ditch at an average cost of 1½c. per foot of ditch.

All operations are controlled through valves located conveniently at the forward end of a large air receiver which is kept charged to about 80-lb. pressure by the air-brake pump on the locomotive. Adjustments of the wings are made easily by one man. The main ditching wing has a vertical operating range from 4 ft. below to 1 ft. above the rail, and the outer end of the wing has a maximum spread of 21½ ft. from center line of track. The machine or car is fitted with a standard air brake, drawbar and coupler, and all U. S. safety appliances, so that it may be hauled in regular trains. It weighs approximately 45 tons. The builder of the wing machine here described is the O. F. Jordan Co., East Chicago, Ind.

Some records of performance and cost of work by this ditching machine on different railroads, as given by the maker, are presented in the accompanying table.

Earthquake Prediction by Geodetic Measurement

A study of the possibility of predicting earthquakes by geodetic measurements is being carried on by the Carnegie Institution, at Washington. According to the report of the director of the U. S. Coast and Geodetic Survey, just issued, "seismologists agree that earthquakes are due to abrupt adjustments of accumulated strains in the earth's crust. It is believed that the strains as they accumulate, prior to the actual convulsion, may cause a gradual distortion of the surface of the earth which can be detected by geodetic methods.

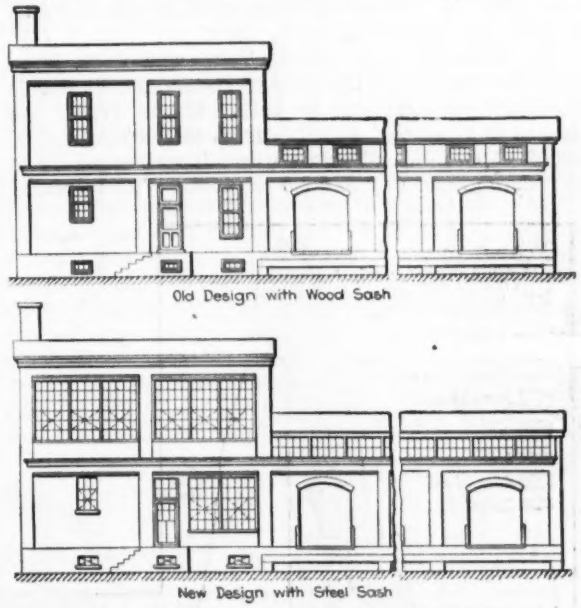
"As a preliminary step, it is necessary to have detailed, precise triangulation and levels in regions of seismic activities, in order that studies may be made of gradual distortions" in the earth's crust prior to shock, the character and extent of the displacement during the earthquake, and the extent of the later readjustments.

Improved Lighting and Ventilation for Railway Freight Houses

By G. P. Richardson
Detroit Steel Products Co., Detroit, Mich.

Good lighting in a freight station eliminates dark aisles and gloomy corners, thus increasing the amount of usable floor space. It also facilitates the handling of freight because the tags and markings can be easily read. This consideration caused the engineers of a large railway company recently to make an investigation of their standard design for freight houses, with a view to obtaining better lighting and ventilation at the lowest cost.

The standard plans provided windows with small lights and wood sash, as shown in the upper part of



OLD AND NEW WINDOW ARRANGEMENT

the accompanying drawing. In the offices the wall spaces were dark and uninviting and in the merchandise storage space were plenty of dark nooks. The monitor had single-sash windows spaced about 4 ft. apart, with brick walls between. For a building 200 ft. long and 33 ft. wide this design provided 220 sq.ft. of lighting area and 31 sq.ft. of ventilating area on each side.

The building was redesigned with large bays of steel sash in the office and a continuous run of steel sash windows in the monitor. This revised design provides 790 sq.ft. of lighting area and 62 sq.ft. of ventilating area on each side of the building. The difference is reported by the engineers as, "an increase of 260 per cent in lighting area and 100 per cent in ventilating area." This is due partly to the larger area of opening and partly to the larger effective area on account of the small size of parts of steel sash as compared with those of wood sash. The total cost was slightly reduced, since the extra windows eliminated equal areas of brick wall, which cost more per square foot than the steel sash glazed. The only objection raised was that the extra glass area may increase heating costs, but the additional heating will be required during only five months in the year and it is in these months that good lighting is essential.

Driving a Five-Mile Rock Tunnel for Japan Railway

Volcanic Water-Bearing Strata—Bottom or Side Headings—Brick and Concrete Lining—Force, Plant and Progress

RELOCATION for the elimination of grades of 2½ per cent on the Tokkaido line of the Imperial Government Railways of Japan involves the construction of a 30-mile cut-off in mountainous country and the driving of a double-track tunnel five miles long to avoid the present line over the Hakone Pass. This tunnel will be the longest in that country and one of the longest double-track tunnels in the world. It is being driven from both ends and each heading has advanced over 5,000 ft. Work was commenced on the new line in 1916 and on the tunnel in 1918.

The Tokkaido line, between Tokyo and Kobe, is an important section of the railway system and its double tracking was completed in 1913. Ruling grades are limited to 1 per cent and its curves to 1,000-ft. radius, except at two difficult points where it was necessary to introduce grades of 2 and 2.5 per cent. With increased traffic the operating conditions warrant the expense of grade reduction. One of these heavy-grade sections is that between Kozu and Numadzu, 37 miles, including the Hakone Pass, noted above, as shown in Fig. 1. The other is a 10-mile stretch between Otsu and Kyoto, where a tunnel 2,181 ft. long will give a maximum grade of 1 per cent instead of the 2½ per cent grades over the open pass.

Atami Cutoff—The longer relocation, known as the Atami cutoff or detour (Fig. 1) reduces the distance between Kozu and Numadzu to 30.2 miles, giving maximum grades of 1 per cent and curves of 1,320-ft. radius (about 4 deg., 20 min.) but requiring no less than 23 tunnels and 72 bridges. There will be eight stations. Very heavy construction work is involved, as the line crosses the valleys of two rivers subject to overflow, skirts the rough, rocky country at the foot of the mountains along the shore of Sagami Bay and then pierces the mountain range which extends across the Izu peninsula. This range, forming part of the Fuji volcanic group, has a steep slope on the eastern or Atami side and an easy slope on the western side.

From the profile, Fig. 2, it will be seen that the tunnel is to pass under the Tanna basin, a circular depression about 1.3 miles in diameter at about 770 ft. above sea level. This is fertile land containing two villages and surrounded on all sides by high peaks. The basin is supposed to be the bed of an ancient lake. An elevation of 250 ft. above sea level is reached in the tunnel, as compared with 1,500 ft. at Gotemba on the original line. A comparison of the two routes is given in Table I.

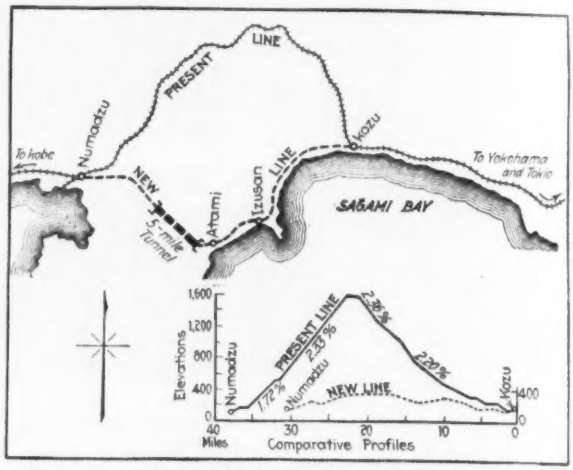


FIG. 1. LOW-GRADE CUT-OFF ON JAPANESE RAILWAY

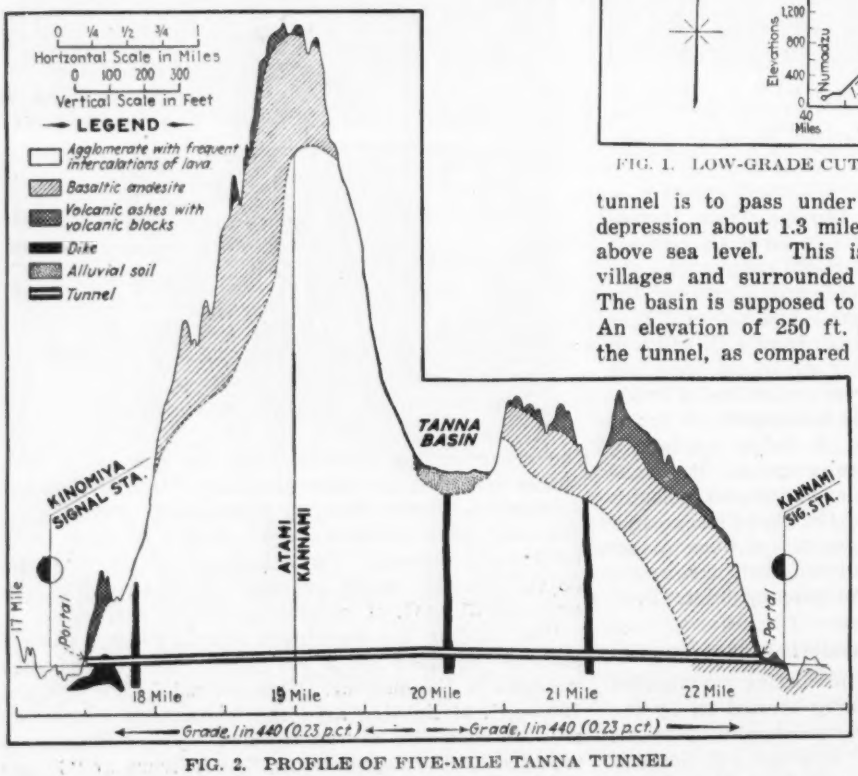


FIG. 2. PROFILE OF FIVE-MILE TANNA TUNNEL

After a rough location of three routes on a topographic map having a scale of 1:20,000, surveys were made for a comparison of these lines and finally a trigonometric survey was made of the selected line. No test holes have been drilled from the surface to the tunnel grade, to check the alignment in driving the tunnel, and it has not been decided whether such holes will be driven. The depth of cover over the tunnel ranges from 200 ft. at the Tanna basin to a maximum of nearly 1,800 ft.

Geological Conditions—Rock strata through which the tunnel will be driven consist mainly of agglomerate containing andesite of various kinds (see Fig. 2). Experience so far indicates that the strata are loose and seamy, containing an abundance of water. Hot geyser springs occur at Atami and Izusan, the latter being close to the shore and 1½ miles northeast of the eastern portal. But neither gas nor hot water are expected to be encountered in the tunnel, since volcanic activity

ceased long ago and the hot springs mentioned are far below the tunnel grade.

Temperatures in the headings are generally higher on the eastern side, probably on account of the proximity of the Atami hot springs, but on the western side the strata contain much more water. On the eastern side the temperature is about 80 deg. F. at 3,800 ft. from the entrance and 960 ft. below the surface. On the western side the temperature is irregular for although it registered 66 deg. at 1,400 ft. from the entrance and 370 ft. below the surface, lower temperatures were encountered at a distance of about 4,800 ft. and greater depth. This condition is due probably to the great amount of water contained in the rock. It is expected that a temperature of about 90 deg. F. will be found at the deepest point, about 1,800 ft. below the surface.

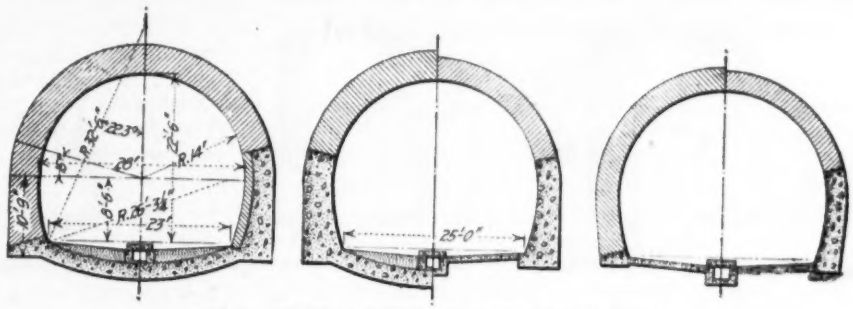


FIG. 3. TYPICAL SECTIONS OF TUNNEL LINING

TABLE I. ATAMI RELOCATION: JAPAN GOVERNMENT RAILWAYS

	Present Line	New Line
Length	37.5 miles	30.2 miles
Height of summit above sea level	1,500 ft.	243 ft.
Total rise and fall	3,018 ft.	721 ft.
Ruling grade	2.5 per cent	1 per cent
Length of ruling grade	12.1 miles	6.7 miles
Total curvature	2,061 deg.	1,431 deg.
Total length of bridges	3,100 ft.	5,300 ft.
Number of tunnels	7	23
Total length of tunnels	7,560	50,596
Equated length of line	72.2 miles	39.3 miles

Tunnel Section—A horseshoe section is employed for the tunnel, with a width of 28 ft. and a height of 22½ ft. above sub-grade to accommodate two tracks of 3½-ft. gage. The semicircular arch has a radius of 14 ft. Lining is to be used throughout, but will vary in form and thickness according to the material penetrated, as shown in Fig. 3. Bricks or concrete blocks will be used for the arch, which varies from 27 to 54 in. but is in general 36 in. thick. Bricks or monolithic concrete, or both in combination, will be used for the side walls. Where an invert is required, this will be of monolithic concrete. A rectangular concrete drain covered with concrete slabs will extend the full length of the tunnel.

The tunnel is being driven mainly on the bottom heading system, but with the widening operated in two different ways. A side heading system will be employed when the nature of the rock makes this advisable.

Principal Bottom Heading System—In ordinary material and for the greater part of the work a bottom heading 7 ft. high and 9 ft. wide is first driven, and is then enlarged to 9 x 12 ft. and timbered, as shown in Fig. 4. A vertical shaft or raise is driven up to the roof line and from this shaft two top headings 7 x 7 ft. are started in opposite directions, the muck being dumped through the raise into cars in the bottom heading.

Each top heading is widened by successive steps, as shown, until it reaches the haunches. Then the roof over the bottom heading is removed and this heading is widened to full section. Finally the forms or centering are placed for the lining.

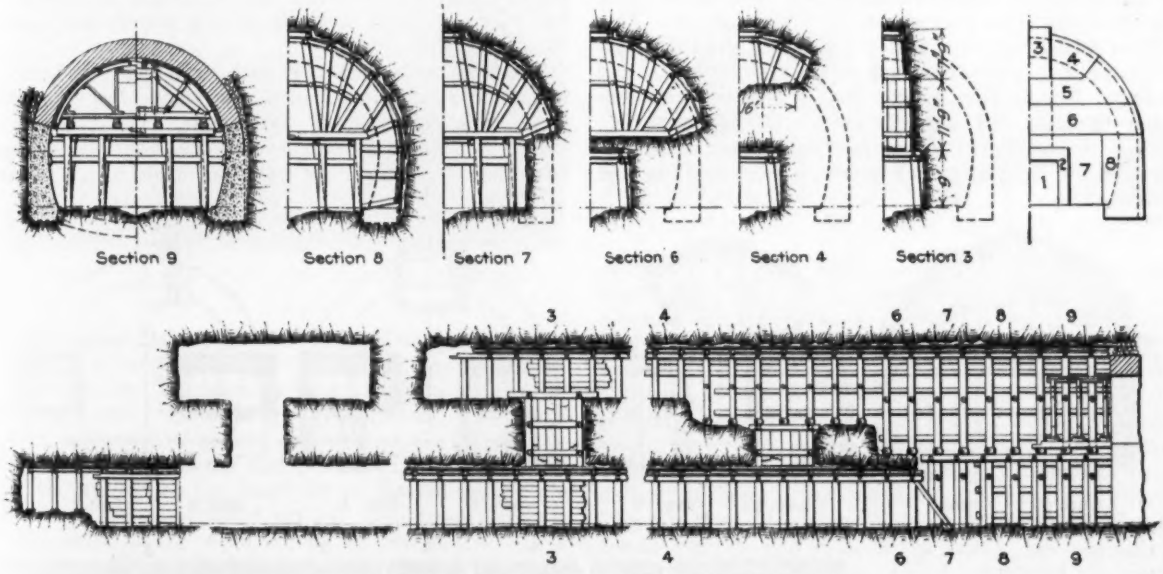


FIG. 4. TUNNELING BY BOTTOM-HEADING SYSTEM

Alternative Bottom Heading System—In hard rock, the first step is the heading and its enlargement, as described above. Then a 7-ft. drift is cut in the roof and raised by successive stages until it reaches the level for a top heading. This in turn is widened and deepened until the arch excavation is completed, all excavated

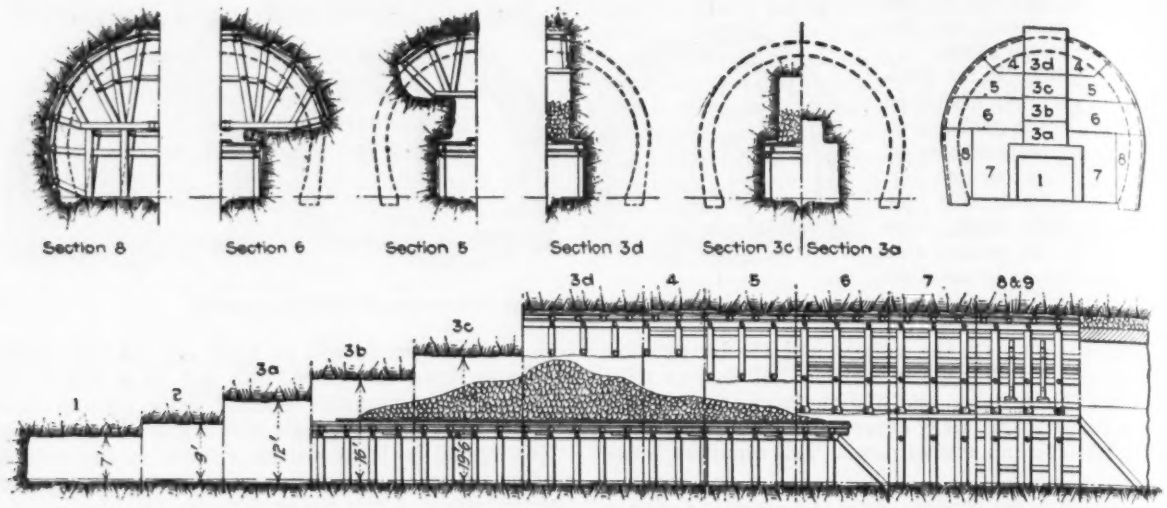


FIG. 5. ALTERNATIVE BOTTOM HEADING SYSTEM

material being dropped on the roof of the bottom heading and loaded through traps into the muck cars. The timbering of the bottom heading is then removed and this heading widened to the full tunnel section.

Side Heading System—In this third method, which is used only under special conditions, two side drifts are first run, just below the haunches. These are widened towards the middle of the tunnel, and at the same time an independent top heading is started. After the side headings have been deepened for the walls and again widened for the invert, the concrete for the side walls is placed. Meanwhile the top heading is being enlarged until the roof excavation is completed. This leaves a middle core of material between the side headings, which is utilized to support the arch centering and forms. Finally this middle core is removed and concrete is placed in the middle section of the invert.

For the ordinary bottom heading system, two compressed air drills are used in the bottom heading and one in the top heading. These drills, working with air at 80-lb. pressure, are mounted on columns wedged against the floor and roof. Dynamite is used for blasting. At the east end, the clearing of the heading after a blast takes about 40 minutes, before men can resume drilling. At the west end this interval is only about 20 minutes.

Three 7-hour shifts are worked in the 24-hour day, the crews being as shown in Table II. Progress in each heading averages 6 ft. per day or 170 ft. per month at the east end, and 7 ft. per day or 200 ft. per month at the west end. In May, 1921, the headings had been advanced 4,000 ft. at the former and 4,800 ft. at the latter.

The muck or blasted rock, with large pieces broken up to convenient size, is loaded into small steel or wood dump cars, on tracks of 30-in. gage. These cars are pulled by men to the point where the tunnel lining has been finished. There the cars are made up in trains

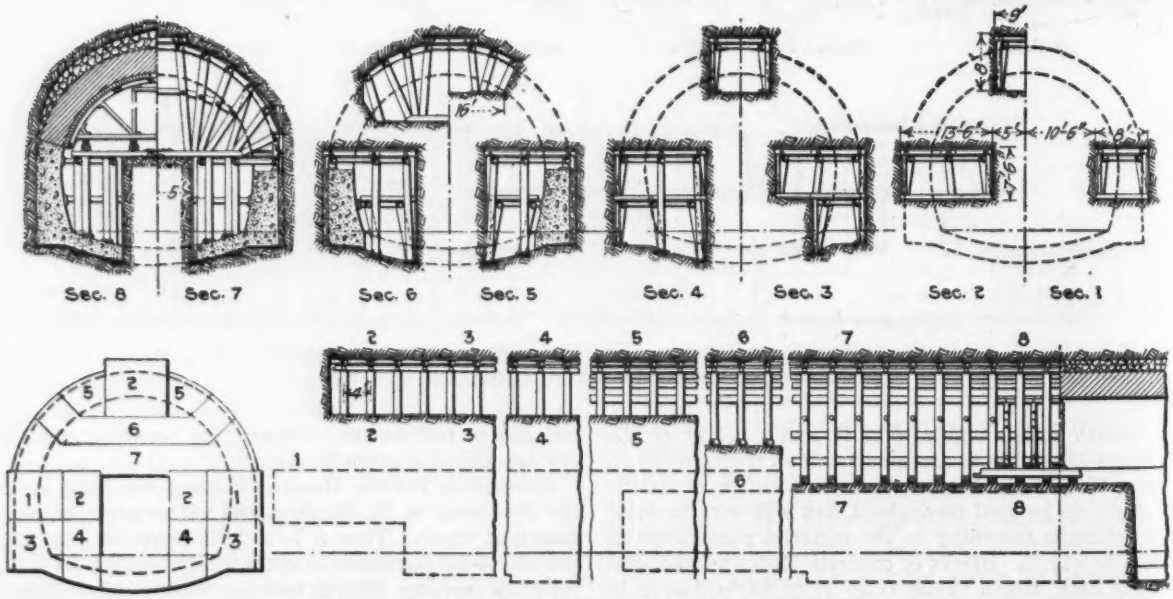


FIG. 6. SPECIAL SIDE HEADING SYSTEM OF TUNNELING

and hauled out by electric locomotives. At first, trains of four dump cars were handled by oxen at the eastern end and by horses at the western end.

At each portal is a compressor plant, the compressors being at first operated by steam. A power plant with turbo-generator has now been built near the west portal, and this furnishes current for both compressor plants and for the ventilating fans, driven by 75-hp. motors. In the first stages of the work, both in driving and

TABLE II. TUNNELING CREWS; TANNA TUNNEL, JAPAN.

	Bottom Heading East	Bottom Heading West	Enlargement East	Enlargement West
Drillers	4	4	24	30
Muckers	10	10	30	30
Carpenters	3	2	10	8
Others	4	3	15	12
	21	19	79	80

widening the headings, the exhaust from the drills was utilized for ventilation. It is not expected that ventilating plant will be needed for the completed tunnel.

Engineers and Working Forces—The total number of men employed per 24-hour day averages 350 at the east end and 400 at the west end. All the engineers, foremen and workmen are Japanese. At each portal there is a camp with offices, houses for the engineers and foremen and quarters for the foremen, as well as offices

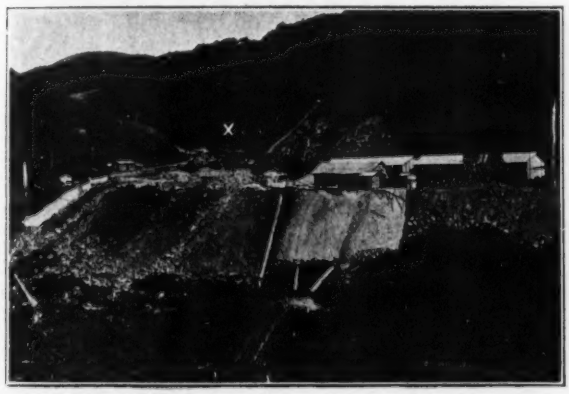


FIG. 7. SOUTH APPROACH TO TANNA TUNNEL

and accommodation for the contractors. No special hospital arrangements are provided, but there are physicians and surgeons to look after the welfare of the men and take care of any injuries. Baths and other accommodations are available at the Atami hot-spring resort, near the east portal.

The driving of the headings is carried on by the forces of the government railway department, but the other parts of the work are let to contractors, either as piecework or in sections. The contractors now engaged are the Railway Engineering Co. for the east end and Seiichi Kashima for the west end.

At the beginning of the work, Yasuichizo Tomita was director of construction, with the following engineers in charge: Hitoshi Takiyama, Ichiro Takemata and Shinichi Takai. At the present time Isami Awoki is director of construction, with the following engineers: Kameji Yamada, Yukito Yamane, Yoshiyasu Katagiri and Hyoma Kurasaki.

Rebuilding Railway Structures In Northern France

Unique Operations Employed to Save as Much of Damaged Structures as Possible—Work on Nord and Est Railways Cited

DESTRUCTION of bridges and other works was experienced doubly by the Eastern Railway of France, first by the French during their retreat in 1914 and then by the Germans in their great retreat of 1918. The destruction carried out in 1914 consisted mainly in wrecking steel spans and some of the arches of masonry bridges; tunnels were blocked by exploding mines which blew up the portals and caused a fall that plugged the interior. An account of the reconstruction work has been given by M. Pellarin, chief engineer of maintenance of way, in the *Revue Generale des Chemins de Fer*, from which article the following brief particulars are taken.

After the first battle of the Marne, the engineer regiments made rapid repairs to the structures in the territory held by the French, using military bridges of of the Henry and Marcille types to close the gaps, no

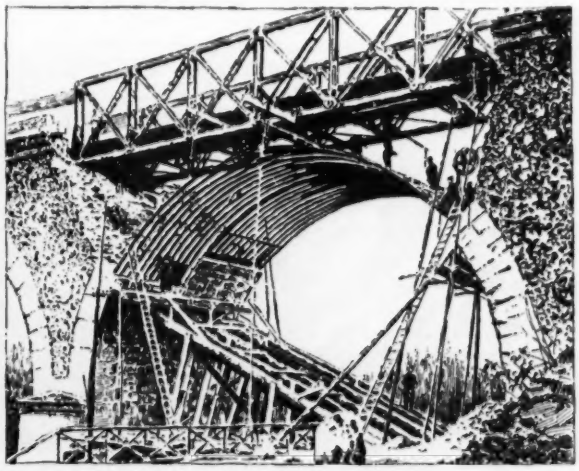


FIG. 1. STONE ARCH BEING REPAIRED WITH CONCRETE

greater length than 130 ft. being required. Where the destruction of an arch had led to the collapse of adjacent piers and arches the reconstruction was left until a more favorable time. All the tunnels were in territory still held by the Germans.

Bridge reconstruction on a permanent basis was left to the railway engineers To rebuild arches in stone would have been slow and difficult work; timber for centering was hard to obtain and it would have been difficult to erect it on the debris blocking the rivers. The plan devised by Mr. Descubes, chief engineer, was to use concrete and to build the arch in two concentric rings, the first and thinner ring having steel reinforcement which formed the centering and gave the arch sufficient strength to carry the second ring until the concrete had set.

At first this reinforcement consisted of 60-lb. rails, bent hot. Fig. 1 shows one of the four arches of the Armentieres bridge near Changis, on the line from Paris to Strasburg, with a steel military bridge over the wrecked arch, the curved steel rails in place for concrete reconstruction and the lower part of the old stone

arch supported by bracing. Breakage of the rails in bending led to the use of light ribs of angles and plates, which were swung into place from the military bridges. Forms for the intrados of the arch were secured either by hook bolts or pieces of old electric cables attached to the ribs. Arch rings and spandrels were faced with stone collected from the wreckage and laid in cement mortar. A layer of asphalt was applied for waterproofing and was covered with lean concrete as a protection.

Much greater difficulties were encountered in the reconstruction work on 580 miles of line released in 1918, as the retreating Germans were not satisfied with destroying the spans sufficiently to check pursuit, but did their utmost to wreck the structures completely, even to the foundations. Culverts were blown up in such a way as to breach the embankments, the destruction of one 13-ft. culvert in a 32-ft. fill causing a gap that had to be spanned by a 122-ft. military bridge. There were 162 steel bridges and 202 masonry bridges almost completely destroyed. Small arches were built in successive rings of concrete, the exposed faces being of portland cement mortar laid against the forms.

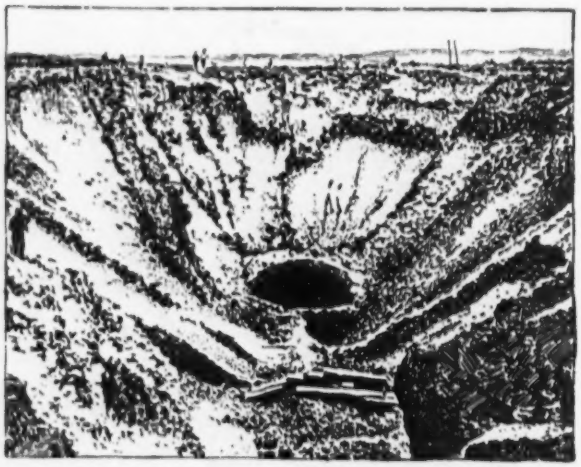


FIG. 2. EFFECT OF EXPLODING MINES IN THE MARNE CANAL

Each tunnel was blown up by the Germans at two or three interior points as well as at the portals, their own men being sometimes buried by the slides. In every case the quantity of explosive was so great as to loosen and disturb the ground for a considerable height above the tunnel. The Marne tunnel, 1,510 ft. long was wrecked for 1,250 ft. by 14 mine holes or wells from the surface, so that this length will have to be rebuilt as an open cut. Fig. 2 shows one of the craters caused by the mines at this tunnel.

Northern Ry. Viaduct Repair—To preserve a viaduct partly destroyed by the Germans, an emergency abutment was built to take the arch thrust while the demolished portion was being rebuilt to enable the line to be reopened for military service. As shown in the illustration (Fig. 3) the support consisted of a heavy timber tower having diagonal members bearing against the last undamaged pier. The top of the tower served as falsework for the removal of a damaged arch. At the right is falsework used in straightening a distorted pier. The Poix viaduct had twelve masonry arches, six of which were destroyed entirely. The seventh arch was badly cracked and the last pier left standing was thrown out of plumb. After the eighth arch had been braced, as shown, the damaged arch was taken down.

To straighten the isolated pier, a horizontal cut about 4 in. deep was made in each face until only a narrow section of solid masonry was left at the middle of the pier. The cutting was done with steel saws working in sharp sand. By means of jacks the pier was then forced into a vertical position and held while the two saw cuts

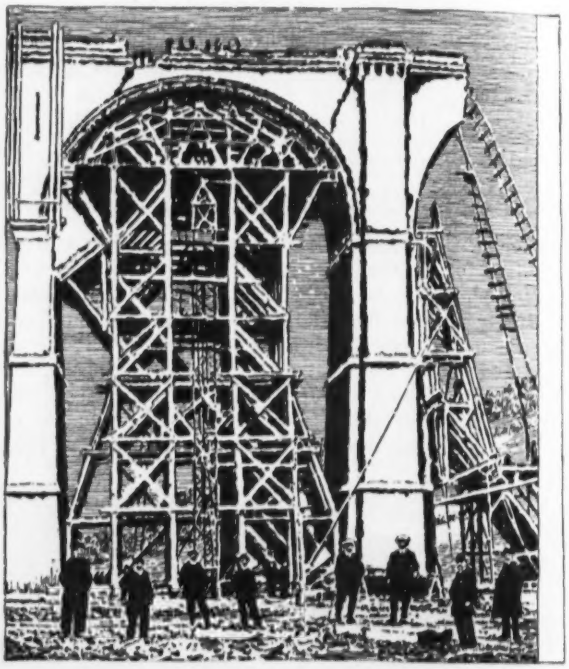


FIG. 3. FALSEWORK FOR VIADUCT REPAIR

were packed with concrete. During this operation the other arches and piers were rebuilt with concrete, a brick facing being applied in order to give an appearance similar to that of the original structure. This facing consisted of bricks collected from the wrecked part of the structure and placed in the forms.

This reconstruction was described in a paper read at Lille, France, by M. Javary, chief engineer of the Northern Ry. No details or dimensions were given, the work being mentioned incidentally as an illustration of the railway's operations during the war. The accompanying view is reproduced from *Revue Generale des Chemins de Fer*, Paris.

Kansas Designates Highway System

In accordance with the Federal-Aid-Highway Act of 1921, which requires the states to designate a system of primary and secondary roads amounting to not more than 7 per cent of the total mileage, Kansas, with a total road mileage in the state of 124,144, has selected a system which includes 3,130 miles of primary roads and 3,445 miles of secondary roads, or a total of 6,575 miles for the state system. The leeway in selection of future routes left by the State commission by not using up the entire one-seventh of the total road mileage is, for primary highways, 594, and for secondary highways, 1,511 miles, or a total of 2,105 miles. In the approved state system there are five primary or interstate highways traversing the state in each direction.

Track Maintenance by Contract on the Canadian Pacific Ry.

Labor Shortage, Heavy Traffic and Short Season Led to Contracting for Extra Gangs—Successful Results of Three Years on 400 Miles

By H. G. Harton
Sydney E. Junkins Co., Engineers & Constructors, Winnipeg, Canada

SUPPLEMENTING the regular railway section gangs by extra gangs operated by a construction company was the method employed by the Canadian Pacific Ry. for carrying on track maintenance at a time when the labor situation made it more practicable to handle the work through an outside company. The contract system was in use during 1918-1920 on the 400-mile stretch of double track between Winnipeg and Fort William. This division carries a large proportion of the traffic originating west of Winnipeg, and at certain times of the year, especially during the wheat movement in the fall, it is operated under extremely heavy traffic conditions.

Maintenance of track on this division presents a particularly difficult problem, due to the fact that the open season during which maintenance can be done effectively is short; usually from mid-April to mid-October. Further, the severe frost action and consequent heaving of the track largely increases the maintenance of line and surface, quite apart from the action of traffic.

The division lies through a region that is almost uninhabited except at either end, at the engine terminal points in Kenora and Ignace, and at a few small towns. The country is wooded, rocky and interspersed with lakes. Muskeg swamps are often encountered, which tend to cause soft track in spite of large quantities of fill. They also require ample drainage ditches, of which some 25 miles were dug during the work here described. There are a few short tunnels through rock points, a considerable number of culverts over the many small streams connecting the various lakes, and a few larger bridges such as those over the Lake of the Woods outlets and the Kaministiquia River. The profile is regular in general, with a rise of about 900 ft. from the level of Lake Superior to the height of land, then a gradual drop of about 800 ft. to the level of the Red River at Winnipeg. Curvature is considerable, especially in the lake sections.

Track construction comprises 80-lb. and 85-lb. rails with angle splice bars on ties 7 x 9 in. and 8 ft. long, laid in gravel ballast. Treated ties have been used as renewals in recent years for 160 miles east from Winnipeg. Shoulder tie plates are placed on curves and on all creosoted ties. Rail anchors are used at all points where the rails travel under traffic.

Contract Maintenance System

Ordinary maintenance work is done in the usual way by section gangs. Owing to the shortness of the working season, previously mentioned, it is necessary to supplement these gangs, even when filled to strength in the summer, by extra gangs. It is the work of these latter gangs that this article describes. The primary motive of the railroad in contracting outside for this extra gang work was to supplement its own meagre supply of common labor in the difficult three years covering the last year of the war and the next two years of readjustment.

Wage rates for track work were considerably lower than those prevailing elsewhere for industrial and construction work; the work itself was usually located many miles from towns or even telegraph stations; all living had to be done in outfit cars or tents. In general, in a time of severe competition for labor in every direction, the proposition involved a considerable element of selling the job to the laborer as more desirable than the many other opportunities he was being offered.

An outside engineering construction company with a flexible organization was thought to be capable of dealing with this kind of a situation somewhat more quickly and easily than the more rigid organization of a railroad. The undertaking, based on a prearranged fee, involved the primary motive that the work was to be done precisely as a department of the railroad; that is, that the construction company should merge its organization absolutely to the needs and direction of the railroad although at the same time keeping it entirely separate and distinct.

Organization and Supervision

Briefly, the organization consisted of a field office at Kenora, Ont. (the railway division headquarters), reporting to the company's main office in Winnipeg. The latter handled general relations, rates and the recruiting of labor. A field superintendent was primarily responsible for field work. Under him were assistant superintendents, paymaster, traveling timekeeper, camp inspector and, at the field office, a field clerk, stenographer and tool man. Reporting each day by wire to the field office were the gang foremen. Under them were the assistant foremen, if the size of the gang demanded, and the workmen. A timekeeper accompanied the larger gangs and reported to the field clerk.

After determination by the railroad management, the major features of the work were administered by the district engineer; the division superintendent of the railway and the field superintendent of the contractor working in close co-operation. The division superintendent passed his instructions to the roadmasters and these in turn conferred with the field superintendent as to the details of the work desired to be done on their respective districts. The contractor's field superintendent also attended the weekly meetings of the division superintendent and the roadmasters, where the various problems arising from maintenance were threshed out.

The net result of this organization was that the daily problems were promptly settled direct between the railway company's roadmasters, the contractor's field superintendent and the gang foremen, while the general policy, changes, additions or curtailments were settled between the district engineer, the division superintendent and the field superintendent, and were then passed on to the roadmasters and gang foremen. In reverse, questions were passed up by the two latter parties and adjudicated by the three principals above mentioned.

This flexibility was especially desirable since over 800 miles of track were being covered, where conditions changed constantly and time was an important element.

Extra gangs organized by the contractor were similar to railway extra gangs. Owing to the nature of the country each unit was entirely self contained, having its own sleeping, dining, cook, store and tool cars. Gangs varied in size from 6 to 100 men. The boarding was done by R. Smith & Co., Winnipeg, who furnished the necessary help, dishes and food in cars supplied by the railroad. As good and sufficient board was a requisite in keeping down labor turnover the closest co-operation was established with the boarding contractor, in order to keep the latter advised of gang movements and strength and of the character of food and service. A second requisite was a clean camp with cars properly roofed and screened, well disposed sanitary arrangements and cook house waste, and a good water-supply.

These were all deemed fundamental requirements and were watched with the closest care. The field superintendent determined these points as his first duty in visiting a camp and any complaints of the men regarding them were at once investigated and, if justified, were promptly corrected. The medical officer of the railroad co-operated in all sanitation matters in addition to purely medical services. Since some one in authority was at every camp in short intervals, living conditions were strictly checked and many of the petty annoyances of the rough living in outfits were relieved.

Although labor during this period was often unreasonable, the response of the men to these attempts in their interest was encouraging. In addition, inquiry was made of each man when quitting to determine the cause for leaving and in this way various minor troubles, not apparent on the surface, were unearthed and corrected. Experience clearly indicated that the handling and housing of casual railroad labor is a broad and considerably neglected field in which conditions have developed making generally for high turnover and low efficiency.

Work of Contract Gangs

Track work that the gangs were called upon to do included practically every class of railway maintenance work, a partial list being as follows:

- Applying tie plates
- Ballasting
- Bank widening
- Changing switches
- Cleaning out old ditches
- Cleaning up station grounds
- Constructing concrete culverts
- Constructing new passing tracks
- Constructing turntable foundations
- Constructing water-tank foundations and water tanks
- Ditching
- Driving foundation piles
- Fencing
- Fighting brush fires
- Grading
- Lining track
- Loading coal
- Loading and unloading cinders
- Loading and unloading new and second-hand steel rails
- Moving water tanks
- Opening and operating new gravel pit and constructing three miles of railroad from the main line
- Operating old gravel pits
- Painting
- Rail renewals
- Tie renewals
- Surfacing
- Tie loading

An equivalent of about 1,000 miles of single track railroad line was surfaced and generally overhauled. About 175 miles of new steel rails were laid and the old steel loaded and shipped out for branch line and other use. In addition, 325,000 cu.yd. of material were dug from pits and used for filling, ballasting and bank widening.

Jobs somewhat out of the ordinary were done, such as moving a water tank at Pine, Ont. This tank measured about 33 ft. high and 24 ft. in diameter, and weighed about 55 tons. After jacking it up, rollers were inserted and with heavy tackle and a hoisting engine the entire tank was moved on to the tracks and 1,000 ft. west to its new location.

Station Gang System

Much of this work was done in the long established railroad way. The chief difference was the introduction of station-gang methods in tie renewals, ditching and culvert construction. Briefly these consisted in letting small sub-contracts, somewhat as grading and other work is let to station gangs on new construction. The general reason for this was that many men could be found who would not work for the day wages offered but who would work, and work hard, on a small contract of their own, netting slightly in excess of day wages.

Culvert work was done on a unit-price basis, with materials and tools furnished to the gang, which was outfitted and boarded similarly to the extra gangs. The members of the gang were usually known to each other and did the work on a share and share alike basis, one member being elected as foreman and handling reports and instructions. Ditching was done in the same way.

Tie renewal by contract was, it is thought, an entirely new method in maintenance work. The road was divided into sections depending on whether the ballast was hard, fair or easy to dig, and a price per tie renewed was established for each section by the district engineer. Gangs of from six to ten men were made up and after choosing a section were given a contract, usually from 5,000 to 15,000 ties.

For the price per tie agreed upon, the old ties previously marked by the section foreman were dug out, the new tie placed, tamped and partly spiked and the old tie piled. Each section foreman was held responsible for the tie-contract work done on his section, especially for the tamping, which was the part most easily skimped. The field superintendent and his assistants followed the work of each gang closely, but as the section foreman was primarily responsible for his track and was on it all the time, his supervision was usually effective.

Spiking was completed by the section gang. The price established per tie was considerably lower than the cost of ties put in by extra gangs, but owing to the greatly increased output per man per day (averaging around 50 per cent) the tie gang could make better than day wages. Various allowances were made in the base price for long ties in the muskeg sections, switch ties, ties in center tracks, spacing ties, where tie plates were installed and other lesser work than complete renewals. Some half million ties were put in by this method and a great variety of interesting points were developed.

Station gangs were paid on quantities determined by the field superintendent and representatives of the railroad, an advance being usually given them during the work and full payment promptly on completion of the work. As some other section of the line always looked better to the gang than where they were actually work-

ing, contracts were made for rather small quantities. When these were finished, the good gangs were given additional contracts on other sections, so that the same gang would often have four or five contracts in one season.

Payment of the extra gangs was made twice a month by check, payable at par at all banking points on the division, based on payrolls made up in the field office from time books turned in by each gang foreman or timekeeper. A traveling timekeeper checked up the gangs constantly. As a further precaution, paying off was rotated among several men. A special effort was made to pay promptly and accurately, as small but important items in maintaining good-will.

Cost records were kept of the usual major items, such as rail and tie renewals, surfacing and lining, ballasting and similar items, but under war and post-war conditions they gave no useful indication except as between the work of the different gangs and their handling by the gang foremen. Varying wage rates still further upset any standards of comparison. The chief criterion of the work was whether the program outlined in the spring was substantially completed in the autumn. The work assigned was fully completed each year. The wage rates paid were often less and never greater than those paid by the railways and others for similar work. Efficiency per man, while suffering in common with all other work in comparison with pre-war performance, was fully as high as, and in most respects higher than, that obtained by usual maintenance methods.

This system of doing the work by means of an organization outside the railroad was proposed originally by Grant Hall, vice-president of the Canadian Pacific Ry., and the work was done by the Sydney E. Junkins Co., Ltd., engineers and constructors, of Winnipeg and Vancouver. It was operated under the direction of J. C. Holden, district engineer, Canadian Pacific Ry., and by the three division superintendents on this part of the line; J. M. MacArthur, J. L. Jamieson and J. J. Horn.

Canada Has Nearly 9,000,000 Population

The 1921 Census of Canada, announced Feb. 24, shows a total population of 8,772,631, compared with 7,296,643 in 1911, or a gain of about 20 per cent. Of the provinces, Ontario and Quebec are far in the lead, with populations of 2,931,264 and 2,349,069. The order of the other seven provinces and the two territories is: Saskatchewan, 671,390; Manitoba, 613,008; Alberta, 581,995; Nova Scotia, 524,579; British Columbia, 523,369; New Brunswick, 388,092; Prince Edward Island, 88,536; North Western Territories, 6,684; Yukon Territory, 4,162. In addition there were 485 men in the Royal Canadian Navy.

Pere Marquette R.R. Builds New Division Terminal

Operating Conditions Improved by Moving Division Point—Special Features of Roundhouse—Flat Switching in Yards

A CHANGE in operating divisions on the Pere Marquette R.R., for the purpose of effecting increased economy and convenience in freight traffic and engine service, led to the selection of New Buffalo, Mich., as a new division point and made it necessary to construct freight yards and an engine terminal at this point. The principal facilities, as shown in Fig. 1, comprise a classification yard, car repair yard, 16-stall roundhouse, seven open radial tracks (to be covered by a future extension of the roundhouse), concrete coaling station with 250-ton storage bin, two ashpits with mechanical handling equipment, a 100,000-gal. steel elevated tank, and locomotive and car shops for light repair work. As the town afforded no sufficient housing for the local employees and the trainmen transferred to this point the railway company has built a hotel for permanent and transient accommodation, the hotel being operated by the company. A new passenger station, with upper floor for division offices, is to be a later development.

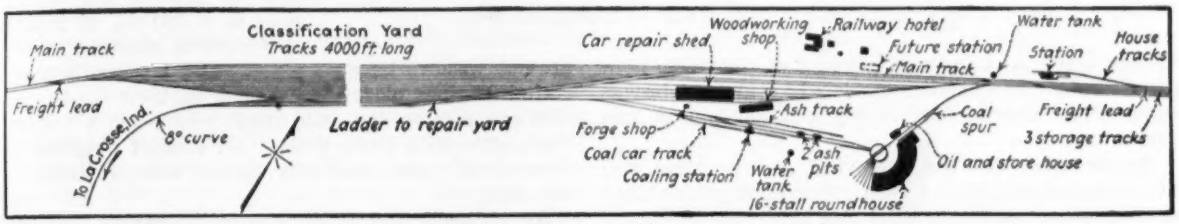


FIG. 1. FREIGHT YARD AND ENGINE TERMINAL AT NEW BUFFALO, MICH.; PERE MARQUETTE R.R.

On the 184-mile line between Chicago and Grand Rapids, Mich., the intermediate division point formerly was at Benton Harbor, Mich., 98 miles from the former, and 86 miles from the latter place. These division lengths were rather short for economical engine and train service. When increased traffic made larger facilities necessary, a study of the conditions showed that it would be advantageous to establish these at New Buffalo as a new division point, since a difference in ruling grades east and west of this place makes it a logical point for making up freight trains. This place is also the junction of the 38-mile branch to La Crosse, Ind., where connection is made with four other roads.

From Chicago to New Buffalo, 69 miles, the tonnage rating of freight trains is 3,200 tons. From New Buffalo to Grand Rapids, 115 miles, the rating is 2,400 tons. The unequal length of the new divisions is an advantage in this case. A short division adjacent to such a busy terminal as Chicago permits frequent movements and round-trips for the engines. With trains made up at the new division point the longer run to Grand Rapids is economical in engine service. At present the average number of freight trains daily, including both eastbound and westbound movements, is six between Chicago and New Buffalo, and eight or ten between New Buffalo and Grand Rapids. Merchandise and general freight constitute the main part of the

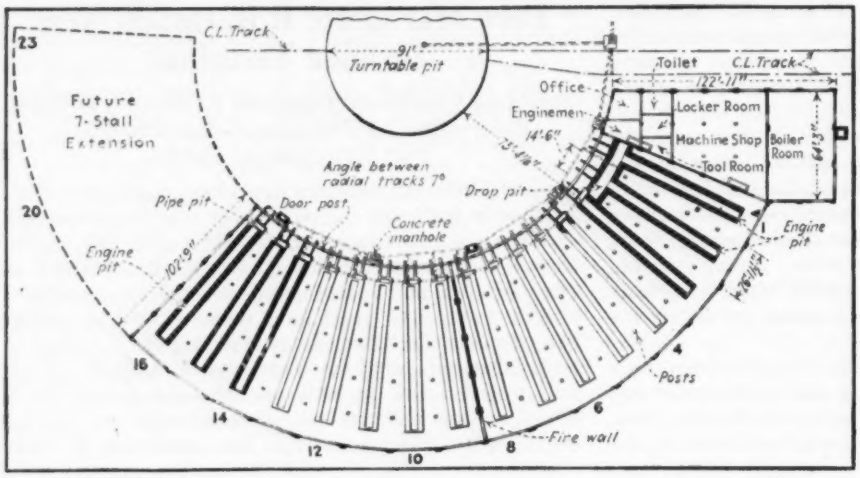


FIG. 2. ROUNDHOUSE WITH DROP PIT AT ENTERING END

freight traffic, and about 20 per cent of the traffic is in solid through merchandise trains which are not broken up at New Buffalo, but simply change engines and crews.

Ample space for the new yard and terminal was available just outside the town. The country is flat and the soil is a fine loamy sand and gravel underlaid by hard blue clay containing sand pockets. There was some difficulty in securing proper drainage, as the clay holds the water in hollows and pockets, so that additional drains have had to be provided at wet spots.

A 15-track classification yard, with tracks about 4,000 ft. long, is situated on the east side of the single main track (see Fig. 1). At the south end, an entrance track or freight lead extends about 4,500 ft. beyond the yard switch, so that freight trains can be kept clear of the main track before they reach the yard. At the north end, there is a similar lead 5,000 ft. long, together with three sidetracks about 2,500 ft. long which are used for storage.

Inbound trains from the main or lead tracks pull into the first two yard tracks. Classification is done on the middle tracks and outbound trains are made up on the outer tracks. All movements are made up by drilling or flat switching, the switch engines working either end of the yard as required. Three switch engines are stationed at this point. The yard tracks have 75-lb. rails and mainly No. 8 frogs, and 15-ft. switch rails for the turnouts from the ladder, and No. 12 frogs for the turnouts at the ends of the yard. All switches are operated by hand.

Parallel with the ladder track at the north end is a ladder serving a car repair yard, caboose track and scale track. The repair yard has four tracks about 1,500 ft. long, and spaced 22 ft. c. to c. Over three of these tracks will be built a car repair shop 64 x 330 ft., of timber construction, adjacent to the present woodworking shop and small blacksmith shop. Switch engines place the cabooses on their tracks and also run cars on the scale track, which has a 300-ton track-scale with 50-ft. table. No general weighing is done at this point, and only certain cars are taken to this scale.

At the north end of the site is the engine terminal, with its turntable approached by one track from the westbound freight lead, and two tracks leading from the classification yard. The former, which has a spur to the coal bin of the boiler room, is used mainly for outgoing engines and for reaching the boiler room and storehouse. Along the other two approach tracks are arranged the coaling station and ashpits, and a water column is located between the tracks. A 90-ft. deck girder turntable of the center bearing type serves the roundhouse and is operated by an electric tractor riding on the circle rail. An open space 73 ft. wide extends between the turntable and the roundhouse.

The roundhouse, Fig. 2, is 102 ft. wide and has 16 stalls, but the layout provides for 23 stalls and four open radial tracks. An annex at one end contains a machine shop, boiler room, locker room and toilets. Only light repair work is provided for, as the main locomotive shops of the railroad are at Grand Rapids and

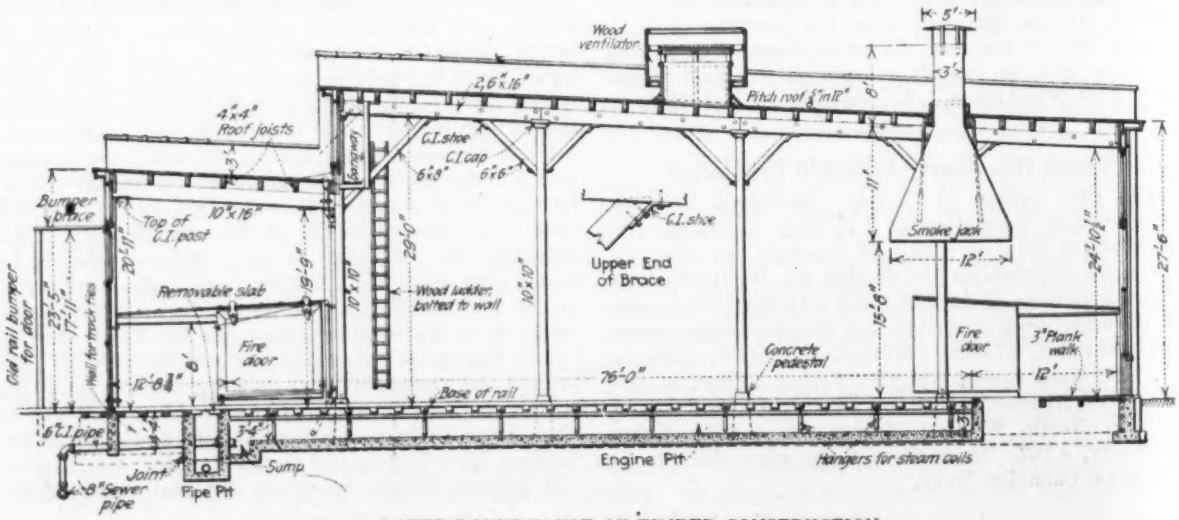


FIG. 3. LOFTY ROUNDHOUSE OF TIMBER CONSTRUCTION

engines can readily be sent to that point. Two 150-hp. boilers supplying steam for heating are served by a steel stack. A separate plant provides for washing out the locomotive boilers with hot water. Brick paving is used in the boiler room and coal bin, asphalt mastic in the machine shop, and concrete in the locker and toilet rooms and under the boilers.

Timber-frame construction of the roundhouse, with brick walls and wood sash, was adopted for reasons of economy. The design is shown in Fig. 3. To secure ample light and ventilation the height is rather greater than usual. The first bay is 20 ft. 11 in. high, but at the second bay this is increased to 29 ft. and then decreased by the roof slope to 24 ft. at the outer wall. In a somewhat similar structure built at Plymouth, Mich., by this same road, the maximum clear height is 32 ft., but this is for a monitor two bays wide. Inside the vertical 8-ft. face of the roof at New Buffalo there is a gangway for convenience in keeping the windows clear.

Four rows of interior posts are supported on concrete pedestals, and have cast-iron caps for the radial beams, which are composed of pairs of 6 x 16-in. timbers with knee braces to the posts. Joists laid parallel with the walls carry plank sheathing covered with tar and gravel roofing. The inner walls consist mainly of rectangular cast-iron door posts. Double swinging doors of wood are used, having glass in the upper panels. When they are open they are latched to posts of old rails 18 ft. high which are braced to the tops of the door posts. This support reduces the tendency of large doors to warp when held only at the bottom. A brick fire wall, with standard fire doors, divides the building into two sections.

Smokejacks of transite board, hung from the roof framing, have hoods 10 ft. long and 12 ft. high, above which they are 36 in. in diameter and extend through the roof. For general ventilation these smokejacks are supplemented by an unusual arrangement of large wooden ventilators in the fourth bay, one over each stall or track. No dampers are provided in either the smoke flues or the ventilators. For general illumination, a well-diffused light is afforded by electric flood lights with 100-watt nitrogen lamps. There are three lamps in each stall, two on the end walls and the third on one of the posts. All the lamps are so mounted as to throw the light horizontally, but they are adjustable in position so that light can be concentrated at points where repair work is being done on the engines.

Concrete is used as usual for the engine pits, Fig. 4, which have convex bottoms and projecting copings to protect the heater coils from falling material. The bottom is reinforced with two layers of steel bars. In the sides are 2-in. iron drain pipes, 6 ft. apart, placed diagonally so as to drain water from the floor into the pit. Each pit drains to an end sump, from which a 6-in. pipe extends to a sewer.

Adjacent to the sump is a pipe pit 30 x 70 in. containing the thermostatic trap and connection to the heating coil in the engine pit. These pipe pits are covered by removable concrete slabs and are connected by a line of 8-in. sewer pipe in which is laid the return pipe for the water of condensation from the coils. Beyond the pipe pit, two concrete walls extend to the wall of the roundhouse and support cross ties for the track (see Fig. 4). This arrangement keeps the tracks

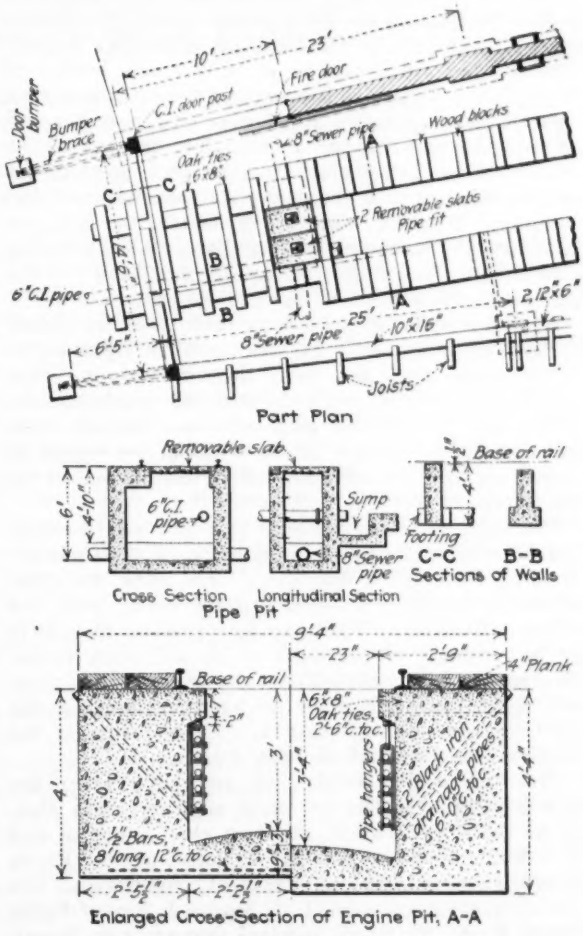


FIG. 4. ENGINE PITS AND PIPE PITS

in surface independent of any settlement of the floor.

Short oak ties embedded in the side walls of the pit carry the 75-lb. track rails and two outside lines of 4-in. planks for jacking. The rails and plank are spiked to the ties. Between the pits the floor is of cinders, but an 8-ft. walk of planks on stringers is laid along the outer wall. An unusual arrangement is that the drop pit connecting two engine pits, to provide for removing an axle and pair of wheels, is located at the entrance end of the roundhouse instead of in the more usual position at the rear end. The reason for this arrangement is that the drop pit is intended to provide only for handling tender wheels, as engines requiring the wheels to be changed will be sent to the main shops. Moveable girders carry the track rails across the drop pit, and when these are to be moved to clear the drop pit they are swung against the sides of the engine pit. The girders slide on angle irons which span the drop pit, but are so placed as not to interfere with the handling of the wheels.

A previous water supply is utilized, with pumping station at the Galien River about a mile distant. From this station a 6-in. main is led to the 100,000-gal. elevated steel tank which serves the general purposes of the terminal and also supplies a 10-in. water column placed between the two engine tracks leading to the terminal.

The 250-ton concrete coaling station serves the two

engine tracks, one of which passes under the storage bin. At the rear is a stub track with track hopper. Coal dumped from cars flows to a single bucket of 2½ tons capacity, which travels intermittently in a steel hoisting tower between the hopper and coal bin and delivers the coal through a chute into the top of the bin. A timber shed over the coal track protects the men working around the cars. As the coal track has a descending grade towards the switch, the cars are moved readily by means of pinch bars. A sand drying plant, with spouts for delivering dry sand to the engines, is an auxiliary to the coaling plant.

At the ashpits, engines drop their ashes into steel buckets which travel on inclined tracks at right angles to the engine track and dump their contents into cars standing on a stub track beyond the engine tracks. There are two ashpits, each with two buckets. Oil and supplies for the use of the terminal are housed in a small concrete store building which has a basement for the storage tanks.

The hotel for the employees is a 50-room two-story and basement structure of red brick. It is U-shaped in plan. On the first floor are a large lobby, the office, lavatory, dining room and first-aid room, with bed rooms in the wings. The upper floor is occupied entirely by bed rooms, with general toilet and bath rooms. Two septic tanks, with effluent discharge to the river, provide sewage disposal for the plant and hotel, as the town has no sewerage system. Electric current for lighting and power is purchased locally.

This terminal was designed and built under the direction of A. L. Grandy, chief engineer, Pere Marquette R.R.; Job Tuthill, assistant chief engineer, and R. J. Williams, superintendent of motive power. Frank Manning was engineer in charge of construction. The general contractors were H. V. Snyder & Son, of Battle Creek, Mich. This new terminal represents an investment of about $700,000.

Railway Bridge Wreck Charged to Crushing of Pier

ON SEPT. 17, 1921, a passenger train on the Pennsylvania R.R., running from Louisville to Indianapolis, was wrecked at a bridge over Blue River near Edinburg, Ind., killing the engine-runner. The wreck destroyed the two spans of the bridge and one end of the bridge pier supporting the two spans; the part of the pier destroyed included the right-hand bridge seat of the two spans. In a report on this accident just issued by the Bureau of Safety of the Interstate Commerce Commission, the wreck is charged to crushing of the pier under the weight of the train, on account of deterioration of the old stone masonry. It is stated, however, that the railway company reached a different conclusion, namely, that "the accident was due to a derailment of the tender from cause unknown." Because of this conflict of opinion and the almost unprecedented cause found by the commission, the facts are here reproduced in abstract from the report.

The bridge was built in 1892, upon old piers and abutments dating from the original construction of the line in 1854. The substructure consisted of native limestone, which had laminated very badly in the course of time. A new coping (or top course) was placed in 1892, but except for one stone replaced in 1916 it is said that no masonry repairs were made since. The superstructure consisted of two through pin-connected truss spans of 126 ft. 3 in. each, carrying single track.

Just to the south of the bridge is a trailing-point switch connecting with a siding on the west side of the main track. The train, running at moderate speed, went into the river to the right (east), and the bridge spans also turned over to the right. The spans came to a position with the floor about vertical; the engine lay upside down at the side of the middle pier, the first car back of the tender lay on its side in the river, and the next car, leaning to the right, hung over the south abutment. The right-hand or upstream end of the middle pier was crumbled away, practically down to water level, on a nearly vertical plane transversely through the pier; in the lower part of the masonry face thus exposed a large mud pocket appeared, which the report explains as a mortar pocket in which silt had been deposited at times of high water.

The condition of the track approaching the bridge and on the bridge, combined with the testimony of the trainmen, presented conflicting evidence as to the occurrence of a derailment. There were marks of derailed wheels from the frog of the switch to the bridge abutment, but none on the bridge ties. The right-hand rail on the approach and on the bridge was turned over to the right, while the left-hand rail was practically uninjured. The right hand end post of the first span of the bridge was broken clean in two, apparently by a blow from an approaching train; a deep mark showed on the right side of the wooden pilot beam of the locomotive, and the front end of the mail car appeared to have received a heavy blow. But in the absence of wheel marks on the bridge ties, it is concluded by the Safety Division of the commission that the engine and tender were not derailed, and that the mail car could not have been 5 or 6 ft. off line when it reached the bridge.

As the general appearance of the wreck indicated a simple turning over to the right, and the bad condition of the masonry warranted the conclusion that it collapsed under the train load, such collapse is concluded to have been the cause of the wreck. On this explanation the train slid over to the right as the bridge turned over and pulled the cars against the bridge members. One of the cars struck the right-hand end post at the entering end of the bridge as a result of this lateral movement while the train was still moving forward, and broke the post.

Engineering Small Part of Road Costs

Primary road engineering in Iowa during the past five years, has been done at an average of 5.91 per cent of the total cost of the improvement. Surveys and plans for 2,225.35 miles of road, since the first law accepting federal aid was passed in April, 1917, cost $472,858.87. This is an average cost of $212.48 per mile for this important part of the work. The estimated cost of construction of the 2,225.35 miles was $26,855,185.97, making the percentage 1.77 for the surveys and plans. Construction work has been carried out on a total of $21,148,242.33 worth of this work at a total cost for supervision, inspection on construction, and inspection and tests of material of $874,403.41, making the percentage 4.14. Thus the total cost of all engineering work chargeable to the primary road projects, the making of surveys, preparation of specification and plans, keeping of records, and all general supervision work, including tests of materials, is 5.91 per cent.

Maintenance in 1921 Failed to Meet Railway Needs

Analysis Shows Deterioration of Fixed Property and Equipment During Year—1922 Must Shoulder Burden of Deferred Maintenance

By Julius H. Parmelee
Director, Bureau of Railway Economics, Washington, D. C.

THAT the roadway, the track, and the equipment of the railways of the United States were in better physical condition at the end than at the beginning of the year 1920 was the opinion expressed by the writer in *Engineering News-Record* of Jan. 6, 1921, p. 33. The facts available at the time that article was prepared warranted nothing more than a general statement, which was based on a summary of opinions secured from railway officials, supplemented by a preliminary study of maintenance expenditures in 1920. During the year considerable information became available, which tended to confirm the opinion cited in the article.

Can the same statement be made of the year 1921? Was the roadway, the track, and the equipment of the railways in better condition at the close than at the beginning of that year? Was railway maintenance in 1921 normal?

Rarely has the question of maintenance been so fully discussed, so hotly debated even, as when it has touched the calendar year 1921. The question was particularly important in that year, for it involved the corollary inquiry as to whether the railways had maintained their properties at the level required by the traffic, or whether they had been forced to increase their meager net income by deferring maintenance work to a more prosperous period.

In this analysis railway maintenance during 1921 has been measured by three different standards: money expenditure, physical work done, and relative condition of properties at the beginning and at the end of the year. Using all of these standards Mr. Parmelee concludes that the maintenance work was not sufficient to make good the deterioration of the plant during the year, either on the basis of normal traffic or on the basis of the smaller traffic actually handled.

As is always the case, exact answers to these questions are neither very easy to ascertain nor simple to set forth.

There are three methods of approach to the question of adequacy of maintenance in a given year. One is to compile statistics as to the amount of money expended for maintenance work in that year, and to compare this amount with corresponding amounts for other years. A second is to compile statistics as to the actual amount of maintenance work done, expressed in terms of physical units of maintenance. A third is to compare the physical condition of roadway, structures, and equipment at the end of the year with their condition at the beginning of the year.

Let us take these methods in order, starting with money expenditures for maintenance in 1921, compared with corresponding expenditures in 1920. Such a comparison shows, on the face of things, a large decrease in 1921, as follows:

	1921	1920	Decrease
Maintenance of way	$764,798,000	$1,031,785,000	$266,987,000
Maintenance of equipment	1,255,187,000	1,593,635,000	338,448,000
Total maintenance	$2,019,985,000	$2,625,420,000	$605,435,000

This shows that during 1921 the railways of Class I expended in maintenance of way work, $267,000,000 less than they did in 1920. In maintenance of equipment work, they expended $338,000,000 less than they did in 1920. The reduction in total maintenance expenditures was $605,000,000, or 23 per cent, as compared with 1920.

Considered superficially, these statistics would indicate a large decline in maintenance work in 1921. Before jumping unreservedly to such a conclusion, however, it is necessary to take into account a number of factors such as the relative level of wages and prices during the two years included in the comparison, the relative efficiency of labor, and the volume of traffic in the two years.

Take the matter of wages. In 1920, effective from May 1, there was a general increase in the railway wage level which has been estimated at 21 per cent. This increased level continued through the last eight months of 1920 and the first six months of 1921. On July 1, 1921, there was a general decrease in railway wages, which seems to have averaged about 11 per cent. It is easy to compute the comparative wage levels of the two years 1920 and 1921 as a whole, making allowance for the 21 per cent increase in effect during eight months of 1920, and the 11 per cent decrease in effect during six months of 1921. This computation develops the striking fact that the average level of wages during the two years was almost exactly the same, taking the railway personnel as a whole. Whether this would apply also to the maintenance forces alone cannot be ascertained except by a long, intensive, and not wholly conclusive investigation; but for the purposes of a general discussion, such as the present, I think we may assume that maintenance wages went up and down at about the same rate as railway wages in general. So far as wages are concerned, therefore, we may consider the relation between the amounts of money expended for maintenance labor in 1920 and 1921 as showing approximately the relation between those items expressed in man-hours. For the first three-quarters of 1921, in fact, the total man-hours of railway labor (all classes) were 26 per cent less than during the corresponding period of 1920.

Another inquiry with respect to wage payments in the two years concerns itself with efficiency. In other words, did a thousand hours expended on maintenance work in 1921 produce any more physical result than a thousand hours in 1920? Many railway officials would answer *yes* to this question, although the relative efficiency of the maintenance forces in the two years cannot, of course, be ascertained with precision.

The price level in 1921 was unquestionably lower than in 1920. The wholesale price index number (all commodities) averaged 243 in 1920, and 153 in 1921, a reduction of 90 points, or 37 per cent. This index number cannot be applied exactly to the railway situation, partly because it covers many items not included in railway purchases, partly because the items which do represent railway purchases are not weighted in the average in the proportion of such purchases, and partly because the railways are forced to buy ahead. Their supply of many important materials represents, therefore, the purchases of several months. Some of the railway purchasing is done on a contract basis, and to such purchasing the current changes in price levels have, and can have, but slight relationship.

It follows that the relative price level in 1921 and 1920 cannot be ascertained with any degree of precision, so far as railway purchases are concerned. On the other hand, it can be asserted, with but little fear of contradiction, that railway prices were lower in 1921, in some cases much lower.

Decline in Volume of Traffic

As to relative traffic in the two years, the results for 1921 stand out as incontestably disheartening. Net ton-miles declined 23.3 per cent, and passenger-miles about 20 per cent, the two traffics combined showing a decrease well above 22 per cent. This decline was the greatest, both absolutely and relatively, that the railways have ever experienced in a single year. Not more than a third of maintenance-of-way work is generally supposed to be affected by, or to correspond to, fluctuations in traffic. In the matter of equipment maintenance, the proportion is of course much larger, although it follows the locomotive-miles and the car-miles more closely than the ton-miles and passenger-miles. In the case of locomotives, it has been estimated that maintenance needs vary according to 80 per cent of the changes in miles of performance; in the case of freight and passenger cars, according to 60 per cent. That is, if locomotive-miles increase 10 per cent, maintenance work should increase 8 per cent, other factors (size, tractive power, etc.) being equal. Similarly, if car-miles increase 10 per cent, maintenance work should normally increase 6 per cent. These are approximate assumptions, of course, but represent the best judgment of competent engineers.

Drawing together our discussion of these four factors—namely, the relative levels of wages, efficiency, prices, and traffic—it appears that the 23 per cent reduction in maintenance expenditures did not represent a corresponding reduction in actual maintenance work, nor on the other hand did it all represent a deferring of needed maintenance.

After taking into consideration every possible difference between operations in 1921 and 1920, of which there were many, and making every possible allowance for the much lower traffic in 1921, as well as changes in other factors of operation, it may be estimated that from one-third to one-half of the $605,000,000 reduction in maintenance expenditures in 1921 did represent an actual deferring of maintenance that would not have been deferred had the financial condition of the railways been stronger, while the remainder is accounted for by the difference in use, the difference in prices, and other changes in operating conditions. It would take too long to discuss this very rough estimate in detail, or to describe the general calculations on which it is based, certainly too long for the confines of this article.

Even in the matter of physical units of maintenance in 1921, it is difficult to speak with precision. Statistics are not yet available for the year as a whole, neither will it be possible, even at a later date, to secure complete information as to the maintenance work actually accomplished in 1921.

From such data as are in hand, however, certain general statements can be made, which it is thought closely approximate the actual conditions. Comparing the 1921 figures with the annual average of the three-year test period as a normal or standard, it appears reasonably certain that:

1. The number of ties laid in 1921 was less than the normal of some 100,000,000 ties.

2. Tonnage of new and second-hand rail laid was below normal. The normal is more than 2,000,000 tons.

3. The cubic yards of ballast were less than the normal of nearly 20,000,000 yards. In connection with these first three items, no allowance is made for difference in traffic, which during 1921 was less than 3 per cent smaller than during the test period. On the one-third ratio mentioned above, but little allowance need be made for this factor of difference in use.

4. The number of locomotive repairs was less in 1921 than in the test period in every class except the lightest of the classified repairs. The number of locomotive-miles in 1921 was less by nearly 8 per cent, which on an 80 per cent ratio would mean a decline of 6 per cent in maintenance work due to lessened use, leaving a margin due to the deferring of maintenance. It should be noted in this connection that the decline in repair work particularly affected the heavy work.

5. The number of freight car repairs declined, chiefly in light repairs. Allowing for a difference-in-use factor of something more than 6 per cent, which on a 60 per cent ratio would mean a decline of about 4 per cent in work due to lessened use, a percentage would still remain representing deferred maintenance.

6. The number of passenger car repairs fell off considerably, while their use in 1921 was slightly greater than in the test period. Clearly there was deferred maintenance in this particular branch of equipment.

Changes in Condition of Equipment

Comparative statistics as to physical condition are currently maintained with respect to only two classes of equipment: locomotives and freight cars.

As to locomotives, the percentage reported to the Car Service Division in bad order—in shop or awaiting shop—was 23.3 per cent on Jan. 1, 1921, and 23.8 per cent on Dec. 31, 1921. This was an increase of 0.5 point in the percentage, and of 347 locomotives in physical terms.

As to freight cars, the percentage in bad order increased from 8.5 per cent on Jan. 1, 1921, to 13.7 per cent on Dec. 31, 1921, an increase of 5.2 points in percentage terms. This represented an actual increase of 121,956 bad-order cars during the year.

Thus there was some decline in the physical condition both of locomotives and of freight cars during the year 1921. It might be argued, and by some it has been argued, that in a period of depressed traffic it is proper to allow the number and percentage of bad order locomotives and cars to increase, on the theory that only the deterioration caused by current traffic need be made

good. However this may be, maintenance of equipment cannot be regarded as normal in 1921.

We have now approached the maintenance situation on the railways in 1921 from three angles. Comparing maintenance expenditures in 1921 with those in 1920, it develops that there was a reduction of slightly over $600,000,000, or 23 per cent, of which at least one-third represented an actual postponement of maintenance work that would have been done under normal financial conditions.

Comparing the physical units of maintenance work in 1921 with those of the average year of the test period, after making allowance for the factor of difference in use according to certain accepted ratios, we find a smaller number or amount in 1921 throughout. This represents deferred maintenance measured in physical units rather than money; when reduced to its money equivalent by applying the average cost of repairs in 1921, the result roughly bears out the estimate of deferred maintenance, arrived at above by a consideration of the more general factors involved.

Comparative physical condition is known in only two classes, both of which showed a decline during the year.

In brief, railway maintenance during 1921 was not sufficient to make good the deterioration of the plant during that year either on the basis of normal traffic or on the basis of the decreased traffic actually handled.

The foregoing discussion will have made it clear, I think, that the exact measure of such deficiency in maintenance cannot be computed or indicated, either in physical or in monetary terms. But that there was a shortage in maintenance is the almost universal testimony of competent observers. It is to be hoped that during the year 1922 traffic will furnish such financial support as will enable the railways not only to keep their maintenance current, but also, in part at least, to make up some of the postponed maintenance of the past year.

Tests of Treatment of Tomato Canning Waste

Experiments on the treatment of tomato canning wastes made by the United States Public Health Service indicate that they can be so purified by sedimentation and double filtration as to create no nuisance when the effluent is discharged into relatively small bodies of water. The tests were made at Amelia, Ohio. They are thus described in a circular issued by the United States Public Health Service:

The wastes treated consisted of the liquids from washing down floors and cleaning utensils and apparatus and those from scalding the tomatoes, but did not include tomato cores, skins, or pulp. The solids, including the pulp, which had to be wasted, were hauled away and ploughed into the ground. The volume of wastes treated averaged about ½ gal. per No. 3 can of tomatoes packed (1,000 cans to the ton).

The liquid wastes were pumped to settling tanks, in which about 85 per cent of the solid matter held in suspension was removed and the citric acid of the tomatoes was largely converted into lactic acid.

The solids separated in the settling tanks were disposed of on beds composed of a few inches of sand resting on a shallow bed of cinders. An area of 2.4 sq.ft. will take care of waste from each 2,000 No. 3 cans of tomatoes packed.

The effluent from the settling tanks was run through a bed of coarse cinders 4.5 ft. deep and later through a bed of sand of the same depth. The rate of filtration through each filter was 75,000 gal. per day. The sand filter effluent was clear and non-putrescible. Fish lived for six weeks in small concrete basins that were supplied only by the filtered waste.

Car Dumper and Coal Conveyors at Coke Oven Plant

Rotary Cradle Serves Conveying Belts—Traveling Bridge Has Belt for Storing Coal and Grab Bucket to Reclaim It

A NEW type of rotating car dumper, a series of belt conveyors and a traveling bridge carrying conveyors and a grab bucket constitute the main coal handling equipment of the new by-product coke oven plant of the Donner Union Coke Corporation at Buffalo, N. Y. This plant is designed to deal with 3,600 tons of coal daily, which the above equipment must handle in an 8-hour day.

The dumper in its normal and dumping positions is shown in Fig. 1, with the receiving hopper in the foreground. Figs. 2 and 3 show the layout of the plant, with the several conveyors and other parts of the

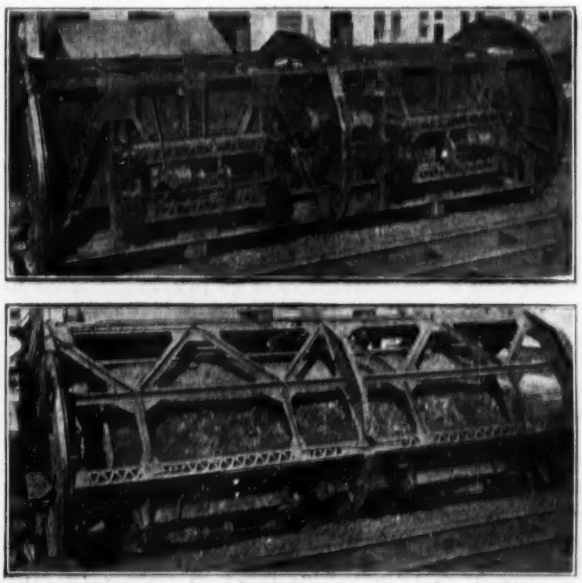


FIG. 1. ROTARY CAR DUMPER FOR 90-TON COAL CARS
Above: Cradle in normal position, showing machinery.
Below: Cradle rolling over to dump coal from car.

equipment. All coal is delivered in open-top cars or gondolas.

Car Dumper—A steel cradle or frame about 50 ft. long, with a circular girder at each end, forms the dumper, the cradle revolving on its horizontal axis and having only a rotary movement. On the periphery of each circular girder is a machined cast-steel ring. This ring rides on rollers mounted in equalizing trucks which are carried by a heavy steel bolster bolted to the foundation (see Fig. 3).

Another circular girder, at the middle of the cradle has attached to it a cast-steel rack engaged by the operating pinion, this pinion being driven by a 40-hp. motor and train of gears. Concrete counterweights balance the cradle, so that its center of gravity coincides with its center of rotation, thus minimizing the power required for operation. In dumping, the cradle revolves through an angle of 150 deg.

Clamping devices to hold the car down upon the rails while being dumped consists of two pairs of top hooks, one on each side, as shown in Fig. 4. Each pair is raised and lowered by a 10-hp. motor with pinion and

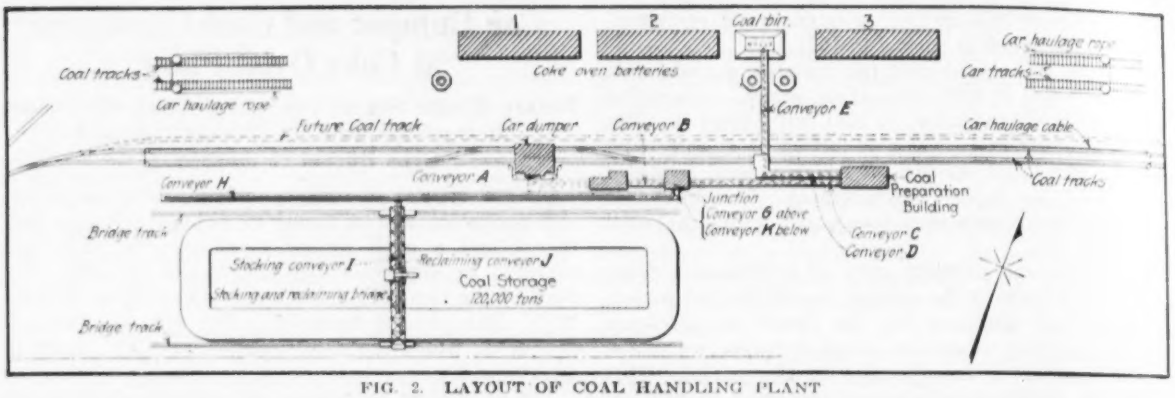


FIG. 2. LAYOUT OF COAL HANDLING PLANT

vertical rack, this mechanism being mounted on the side of the cradle (see Fig. 1). An equalizing device in the gearing insures both hooks coming to a firm bearing on the top of the side of the car.

To support the side of the car when being tilted, two movable side platforms or panels are provided in the dumping side of the cradle, moving horizontally between the truss members. Each is operated by a 6-hp. motor, this mechanism also being shown in Fig. 1. The panels are moved inward until they come in contact with the side of the car. In Fig. 4 these panels are shown advanced, on the left of the track, with the holding-down clamps above them.

An end lock operated by hand secures the dumper at either end of its travel, and is so interlocked mechanically with the control system that it is impossible to operate the dumper unless the top and side clamping devices are in full contact with the car. Limit switches are provided on all the moving parts, and air buffers cushion the cradle at the limits of its rotary motion.

For handling cars to and from the dumper there is an electrically-operated rope-haulage system (see Fig. 2), thus eliminating the necessity for a yard locomotive and switching crew. All yard and dumper tracks are at grade. The movements of the dumper are operated electrically under control of one man in a cabin located above the tracks and at a point where he can observe the cradle and also control the car haulage system. This dumper is designed to handle open-top cars up to 90 tons capacity at the rate of 20 to 25 cars per hour. It can take cars from 26 ft. to 45 ft. in length from 9 ft. to 10½ ft. outside width and from 6 ft. to 11 ft. 3 in. high above the rails.

Conveyor Belts and Bridge.—Coal from the overturned car falls into a receiving hopper (See Fig. 3), at the bottom of which is a duplex shaking feeder which delivers the coal at a uniform rate to a series of belt conveyors. These conveyors deliver the coal either to a storage yard or to a building in which it is crushed and mixed for use in the coke ovens. The storage yard is served by a stocking and reclaiming bridge.

A 42-in. lateral conveyor, *A* (see Figs. 2 and 3), receives the coal from the feeder and delivers it a similar longitudinal conveyor *B* which takes it to the junction house. If the coal is to be prepared for the coke ovens a continuation of this conveyor, *C*, carries it to the crushing and mixing house. The prepared coal goes out from the building over the two 36-in. conveyors *D* and *E*, to be distributed in the coal bin by a 36-in. shuttle conveyor, *F*.

Coal for storage is transferred at the junction house to a 42-in. cross conveyor *G* and fed to a 42-in. longitudinal reversible trunk line conveyor *H*, running parallel with the storage yard. Over this conveyor is mounted a traveling tripper, which, with its accompanying hopper and spout, automatically discharges the coal from the main conveyor to the 42-in. stocking conveyor *I*, on the bridge. Another tripper over the belt discharges the coal from the conveyor at any desired point. In this way the distribution of the coal on the stock pile is accomplished with very little labor and without the use of a grab bucket. There is storage space for 120,000 tons of coal.

For reclaiming coal from storage there is a traveling tower with hoist mounted on the top chords of the bridge and equipped with a 3-ton grab bucket which takes coal from the pile and discharges it into a small receiving hopper. From this hopper the coal flows to

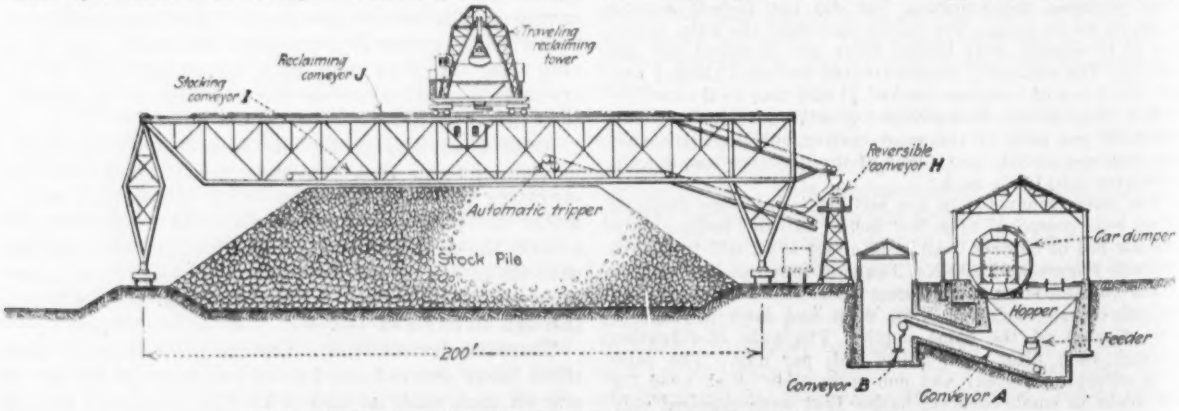


FIG. 3. CROSS-SECTION SHOWS CAR DUMPER AND COALING BRIDGE

a 36-in. reclaiming conveyor *J* on the bridge and is thus delivered to the trunk line conveyor *H*, this latter being reversed to carry the coal back to the junction house. At this point a 42-in. cross conveyor *K*, underneath the conveyor *G*, transfers the coal to conveyor *C* for delivery to the preparation building.

The car dumper was designed by the engineering forces of the Robins Conveying Belt Co., and the

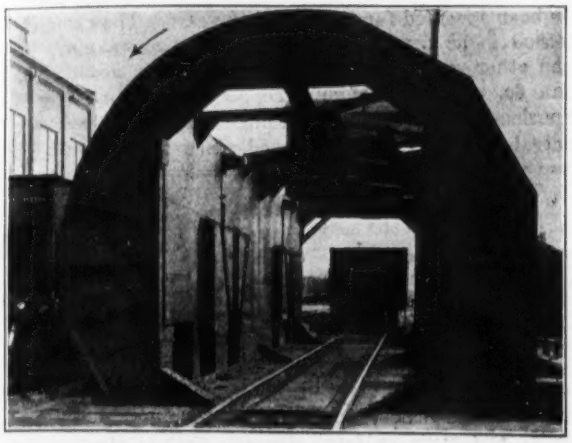


FIG. 4. END VIEW OF DUMPER, WITH LATCHES FOR CAR

Scherzer Rolling Lift Bridge Co., Chicago. Other installations have been made and plans have been prepared for a machine to handle coal cars up to 120 tons capacity. The Robins Conveying Belt Co. built the dumper and also designed and built the conveyor equipment and traveling hoist.

State May Not Dictate Pure Water Source

The State Board of Health of Kentucky has power to require a water company in that state to stop supplying impure water, but no power to dictate the means that shall be employed to provide pure water, according to a decision of the Court of Appeals (Prunell et al *v.* Maysville Water Co., 234 S.W., 967). The decision is really broader in its application than matters of water supply, apparently covering the abatement of any nuisance that is a menace to health, as may be seen from the following extract, as given in a United States *Public Health Reports* for Jan. 27, 1922:

. . . We have no doubt that the state board of health may, under said section 2057, abate any nuisance in this state caused by filth which induces sickness. In this respect the powers of the board are broad, but not unlimited, and must be exercised within a sound discretion; not whimsically or capriciously nor arbitrarily. If the board of health in dealing with such matters does not exceed its powers nor abuse its discretion, its orders will be upheld by courts as final and conclusive. . . .

Although, as said above, the board of health has the power to abate a nuisance, source of filth or cause of sickness, it has no mandatory power enabling it to direct the method by which the result shall be accomplished. It can only cause the abatement of the nuisance, and is not concerned with the method by which it is done. In other words, it may stop the furnishing of impure and dangerous water to a community, but it has no power to direct a water company to install any particular character of plant for sedimentation, filtration, or chlorination of the water, and the water company may adopt any system that may seem best or expedient to it, if the system adopted produces the results desired—clear, soft, wholesome water. . . .

Calcium Chloride in Concrete Highway Construction

Laboratory and Field Tests Indicate Accelerated Setting and More Economical Curing Method Than Usual Practice

BY B. H. PIEPMEIER AND H. F. CLEMMER
Engineer of Construction Engineer of Tests
Division of Highways of Illinois

DURING the past year actual practice and laboratory experiments have demonstrated the value of calcium chloride in highway construction to such an extent that the Division of Highways of Illinois has not only allowed its use for accelerating the setting of concrete in cold weather construction but is also advocating it as a simpler and more practical method of curing than any now in actual practice. Laboratory investigations in curing concrete were conducted on a huge scale, every known and advocated method being tried out. Over 450 specimens were made and tested for transverse strength. In all of the experiments made the specimens treated with calcium chloride showed the best results. Several methods of applying this chemical

FIG. 1. MOISTURE ACCUMULATED ON EARTH COVER OF PAVEMENT AFTER USE OF $CaCl_2$

were tried, but the greatest strength was obtained in the specimens which were sprinkled with the granulated chemical in the proportion of 3 lb. per sq.yd. of surface. This method of curing brought greater strength to the specimens at the end of 14 days than did the wetted earth method at the end of 28 days.

It was thought that heavy rains might wash the calcium chloride from the pavements and thus destroy the curing properties of the chemical as far as the pavements were concerned. To determine the exact result of such action, tests were made with specimens from which the granular chemical was washed off at the end of a 12-hour application. It was proved conclusively that the curing process of calcium chloride takes place within the first 24 hours of its stay on the concrete and after that length of time does not aid curing to any appreciable extent. As the chemical is applied to the pavement from 8 to 16 hours after the concrete is finished, it would be an easy matter to place

TABLE I—TRANSVERSE STRENGTH IN POUNDS PER SQUARE INCH AT END OF 14 DAYS.

Treatment	Modulus of Rupture Average of 5 Specimens
No treatment given. Specimens exposed to air	776
Calcium chloride applied dry to surface, 3 lb. per sq. yd.	952
Covered with dirt 2 in. thick, wet for seven days	812
Calcium chloride 3 lb. per sq. yd. applied with dirt 1 in. thick	791*

*Calcium chloride applied in concentrated solution.

it and protect it from rainfall if the weather looked threatening, or to make the second application in case the first was washed off.

Tables I and II show the results and methods used in a typical series of tests made by the Bureau of Tests. In this series the specimens were made and cured in concrete forms which gave a practical condi-

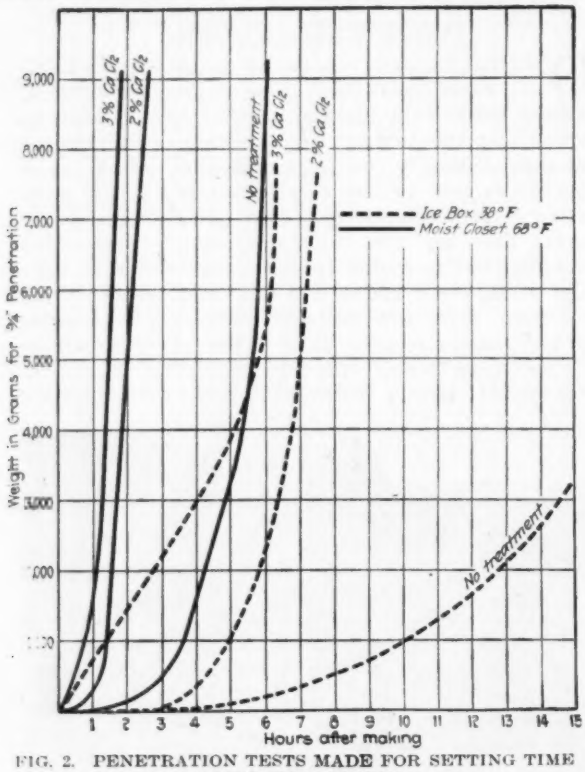


FIG. 2. PENETRATION TESTS MADE FOR SETTING TIME OF TREATED CEMENT

tion of concrete against concrete, approximating that of a slab being cut out of a pavement.

Actual curing of concrete pavement with calcium chloride was accomplished to some extent during the past construction season with favorable results. In one case 7 miles of pavement were cured by first covering the slab with about an inch of earth and then sprinkling the earth covering with a rich solution of calcium chloride. The solution was applied at such a rate as to

TABLE II—TRANSVERSE STRENGTH IN POUNDS PER SQUARE INCH AT END OF 28 DAYS.

Treatment	Modulus of Rupture Average of 5 Specimens
No treatment given. Specimens exposed to air	736
Covered with dirt 2 in. thick, wet for 3 days	785
Covered with dirt 2 in. thick, wet for 7 days	761
Covered with dirt 2 in. thick, wet for 14 days	768
Calcium chloride applied dry to surface, 1 lb. per sq. yd.	822
Calcium chloride 1 lb. per sq. yd. applied with dirt 1 in. thick	794*
Calcium chloride, 3 lb. per sq. yd. applied with dirt 1 in. thick	802*
Covered with asphalt, ½ to ¾ gal. per sq. yd.	820
Calcium chloride applied dry 3 lb. per sq. yd.	907

*Calcium chloride applied in concentrated solution.

insure approximately 4 lb. of the chemical per square yard of surface. The earth covering was used to hold the solution on the surface of the road and to prevent complete loss in case of a heavy rain.

The solution for curing was taken from water barrels which were placed at specified intervals along certain portions of road the day before those particular sections were completed. When the road was finished the proper amount of calcium-chloride solution was applied to the surface of the pavement by use of an ordinary sprinkling can. Inspection was made frequently and it was noted that the earth covering at all times was moist, which proved beyond a doubt that the pavement was satisfactorily cured.

Tests indicate that the granular calcium-chloride method of curing concrete has decided advantages over the method of wetted earth covering or ponding which has been specified for the past few years. The chemical method is as economical and in many cases more so than other methods, as it can be used at a cost of less than 6c. per sq.yd. of surface. A saving in labor is experienced in using calcium chloride, especially where central mixing plants are used since there would be

TABLE III—TENSILE STRENGTH OF STANDARD MORTAR BRIQUETTES

(Average taken of 3 Specimens) in pounds per square inch.

Storage	No Treatment Tested at 2 Days	No Treatment Tested at 7 Days	2% *Calcium Chloride Tested at 2 Days	2% *Calcium Chloride Tested at 7 Days	3% Calcium Chloride* Tested at 2 Days	3% Calcium Chloride* Tested at 7 Days
Damp Closet Temp. 68°	175	320	200	310	208	310
Ice Box Temp. 38°	33	142	57	206	57	191

*Calcium chloride dissolved in mixing water.

no necessity of putting in a pipe line. Further advantages of the calcium-chloride treatment lies in the earlier and more uniform strength that is attained by the concrete when this method is used. Due to this feature, it would be possible to open roads to traffic without danger to the concrete at an earlier date than ever before.

The investigations in regard to placing concrete in low temperatures have indicated that between 2 and 3 per cent of calcium chloride by weight of cement, incorporated in the mix, produces the best results in hastening the setting process of the cement, in securing an earlier strength in the concrete and in preventing injury to the pavements by the action of frost or freezing. Uniform distribution of the chemical is secured by dissolving the material in the mixing water.

The laboratory experiments consisted of making comparisons in strength and setting time of specimens

TABLE IV.—COMPRESSIVE STRENGTH AT END OF SEVEN DAYS

(Average taken of 3 specimens) in pounds per square inch.

Storage	No Treatment	2% *Calcium Chloride	3% *Calcium Chloride
Damp Closet Temp. 68°	2,100	2,185	2,259
Ice Box Temp. 38°	774	1,158	1,136

*Calcium chloride dissolved in mixing water.

containing variable amounts of calcium chloride. The specimens were made up in sets of six, three specimens of each set being placed in an ice box (temperature 38 deg. F.) while the other three were stored in a moist closet (temperature 68 deg. F.). At the end of two and seven days the specimens were tested for tensile strength, and at the end of seven days were tested for compressive strength. The results of these tests are given in Tables III and IV. Small truncated cones of neat cement were made up and stored in the same manner as the other specimens and were used in the penetration test for determining the setting time. A uniform penetration was secured in every test through the use of varied weights on the penetration needle. The idea in causing a fixed penetration to be made was to eliminate any errors which might have been present due to early surface hardening. The penetration used in all cases was ¾ in. In Fig. 2 are curves which

illustrate the setting action of cement in relation to the weights causing the penetration.

It is to be noted that in the laboratory tests for tensile and compressive strength the specimens containing 2 per cent of calcium chloride showed higher strength than those containing 3 per cent of the material, while the specimens which contained the higher percentage reached a set earlier than the others. Though no tests were made on specimens containing 2½ per cent of calcium chloride, that amount would probably produce the best results in both strength and early setting time. Due to the variation in action of calcium chloride with different cement, it is thought that no fixed percentage of amount of the chemical should be advised for all cases but rather a sliding percentage should be used, such as, from 2 to 3 per cent.

For the field work the chemical was purchased in granular form, either in steel drums or in 100-lb. bags. It was dissolved in about equal parts of water and then added to the mixer drum before the mixer was charged with the batch. A sufficient amount of the chemical was added to each batch to insure a content of about 2 per cent by weight of the amount of cement. This method permitted the road to be finished much more satisfactorily and within a few hours after the mixer had shut down at the close of the day's work.

A granular calcium chloride was also used in a few instances on the subgrade to keep down the dust and to prevent freezing of the subgrade when a low temperature was expected. In these cases approximately 2 lb. per sq.yd. was sprinkled on the subgrade.

Though calcium chloride will prevent concrete from being injured by moderately low temperatures, it was thought that freezing weather might damage the concrete and contractors were required to cover pavements with straw or earth during extremely cold weather. In spite of the fact that calcium chloride might not safely protect concrete at all times, its use allows considerable fall construction. In consequence many short gaps are closed in stretches of pavements, which would otherwise be left unfinished until the spring construction season.

The German Sewage Sludge Centrifuge

Unwillingness on the part of the makers of the sludge centrifuge in use at the sewage-works of Frankfort, Germany, to certify that the liquid from the centrifuge would contain no larger percentage of suspended solids than liquid from filter presses is noted by Reginald Brown in a letter to *The Surveyor* (London, England) of Feb. 10. Mr. Brown had been impressed with the centrifuge in other respects and offered to install a plant in England if the guarantee mentioned were promised.

Waterproofing, Joints and Drainage in Concrete Bridge

Some Details of Practical Design and Construction for Both Arch and Girder Types of Highway Bridges

Abstract of the Report of Committee 8-2 on Reinforced-Concrete Highway Bridges and Culverts, American Concrete Institute; A. B. Cohen, chairman. Presented at Annual Convention, Cleveland, Ohio, Feb. 13-16, 1922.

The embodiment of good practice is not confined to theoretical economies based upon actual quantities of concrete, steel reinforcement and other materials; of equal or greater importance is the surety of a positive water repellent protection, the development of an effective expansion joint, the determination and arrangement of construction joints that will not weaken the structure nor exceed the capacity of a plant layout commensurate with the magnitude of the work and finally the distribution of a drainage system to down-spouts and so arranged as to minimize the concentration of water at the expansion and construction joints or at the termination of the flashings of the waterproofing medium.

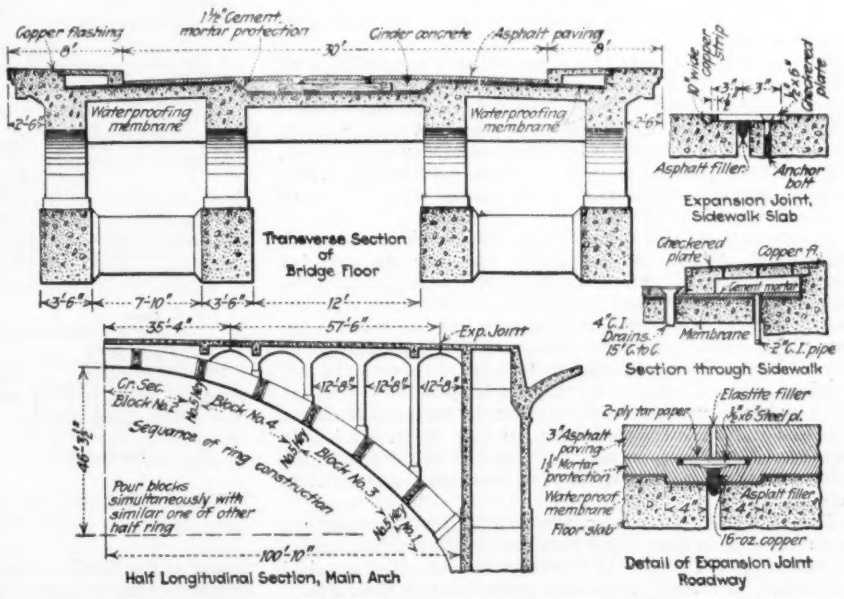


FIG. 1. DETAILS OF A TYPICAL REINFORCED CONCRETE ARCH BRIDGE SHOWING EXPANSION JOINTS AND WATERPROOFING

WATERPROOFING

In general concrete work, waterproofing systems can be divided into three classes, the membrane, the integral and the painting or plaster treatment.

The membrane system consists of the laying or building up of a water repellent blanket over the surface of the concrete—the bridge floor, the back of a barrel arch, the inner face of a parapet wall or any other surface exposed to drainage or to hydrostatic pressure. The waterproofing medium is a bituminous product, either an asphalt or a coal tar pitch. The bitumen, applied hot to the surface of the concrete, is reinforced and held in place by laying a treated or untreated sheet of felt, paper, burlap, cotton cloth or a combination of these materials after each swabbing of bitumen. The number of plies vary from two to five depending upon the kind of membrane used.

The integral method consists of the incorporation of a compound, either in paste, liquid or powdered form, with the concrete ingredients during the mixing to give greater flowability by lubrication of the surfaces of the aggregate or resulting in further hydration of the cement, both principles intended to produce maximum density or such other chemical

action intended to decrease the permeability of the concrete.

The painting or plaster treatment consists of the application of bituminous or other paints, or the integral method used in cement mortar and applied like plaster to the surface of the concrete. A rubbing treatment also has been used in which the compound is worked into the surface of the concrete intended, by act of chemical or physical assimilation, to eliminate permeability of the concrete.

It is not considered that the integral methods have a function in waterproofing concrete bridges of such size that construction joints are unavoidable. The interruptions in the continuity of the surface that is to be protected by reason of both the incipient cracks that do develop regardless of the amount of reinforcement and the necessary expansion and construction joints make such methods inapplicable.

The aggregate may be so proportioned, treated and mixed that the resulting mixture would give a concrete of the highest degree of density, but the fact must not be overlooked, in the final analysis, that the actual density of the finished product depends largely in the manner in which the concrete is deposited in the forms. This is not controlled by the perfection of the mix, physically or chemically, but there remains a personal equation which is not fully controlled on any work.

The membrane system of waterproofing is a guard against possible defects in concrete bridge construction and has been used in a most effective manner. Regardless of the surface porosity or the incipient cracks that may develop, the expansion and construction joints necessary to the work, the membrane system is real insurance against disintegrations known to unprotected structures at these points of susceptive weaknesses.

At present this limits the field to the biuminous compositions, asphalt and coal tar pitch. As between coal tar pitch and a properly refined asphalt your committee is of the opinion that the physical properties of the latter is better suited to meet the outstanding requirements of service; because of the close proximity of the material to the surface of the structure, it is subjected to structural movements and shock of impact through wide range of temperature. Coal tar pitch is more susceptible to changes in temperature than asphalt; its consistency changes from an extremely brittle solid at 40 deg. F. to a very soft fluid at 115 deg. At the lower temperature the quality of ductility is completely lacking.

Not all asphalts, however, are suitable for waterprofing; some of them, in fact, being very poor waterproofing agents by reason of the fact that they lack the essential physical properties, or contain impurities prejudicial to their life.

Waterproofing Details of Design

Plans should show full detail of the waterproofing system, including provisions for flashing ends of the membrane, for folding membrane at expansion joints to guard against fracture due to excessive movement and for flashing at the down-spouts. Plans should avoid the fastening of street car rails with anchor bolts to the floor in an endeavor to eliminate the tie since much trouble has resulted by reason of this detail, which arrangement prohibits a positive continuous waterproofing blanket. If possible, the waterproofing membrane should not be terminated on face of curb in the gutter, as this places the termination at the point of almost perpetual dampness. Several successful schemes covering usual conditions of design are illustrated in Figs. 1 and 2.

Preparation of Surface.—All concrete surfaces to be waterproofed should be carefully floated to a smooth surface, embedding or removing such large projecting aggregate that might puncture the membrane.

Clean surface thoroughly by use of a stiff corn broom followed by a soft broom for removal of dust and finer particles. It is desirable to have the surface perfectly dry. but a little dampness or even a slight greenness of concrete will be allowable when the saving of time is an important element.

Protection of Membrane.—The waterproofing membrane should be protected, in the case of a barrel arch supporting earth fill, by a 1½ in. layer of 1:3 cement-sand mortar or by a layer of common brick laid with open joints, filled with cement or asphalt or by any other equivalent protection. This protection should be applied immediately after the waterproofing has been laid to prevent it from being punctured by subsequent construction operation. An asphalt pavement never should be applied directly over a waterproofing blanket, as subsequent repairs to pavement could not be made without puncturing the membrane; here is another function of the protection coat. Vertical wall work in contact with back fill is protected by one-half inch plaster coating which can be made to adhere readily to the asphaltic surface.

Since the coefficients of expansion of steel and concrete respectively are approximately equal, reinforced-concrete structures of appreciable size require expansion joints in manner similar to practice controlling steel design. By

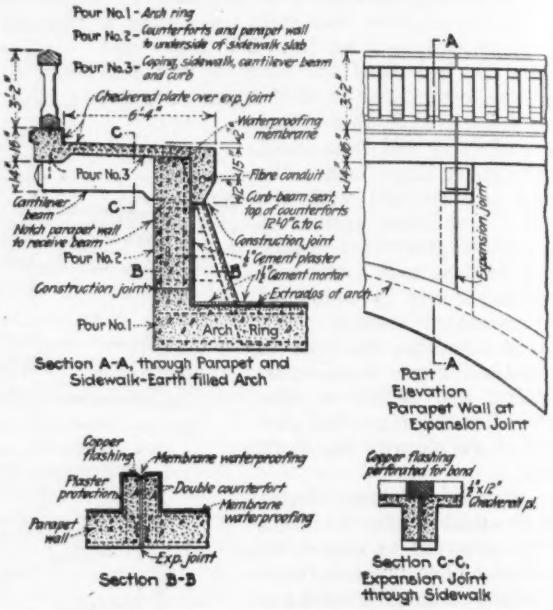


FIG. 2. DETAILS OF EXPANSION JOINTS THROUGH BRIDGE SIDEWALK

reason of the tensile strength of built up sections of a steel member, structural steel carries the stress due to temperature changes over greater lengths without rupture, than the less elastic reinforced-concrete section. Therefore, it is necessary to place expansion joints in concrete construction at even closer intervals than would be necessary in steel structure of similar magnitude.

In concrete structures the distance apart of these joints depends upon the type of structures and no specific recommendations relative thereto can safely be given. Recommendations covering general considerations can be made, however, that will give good index to conclusions for the varying conditions encountered in concrete design.

Broadly speaking, there are three types of highway bridge design requiring expansion joints; first, the arch type with superstructure composed of transverse or longitudinal walls supporting a floor system or with back fill of earth where the sidewalk construction is cantilevered from a parapet wall; second, the T-beam or rectangular slab design supported on columns or bents; third, the multiple way reinforced flat slab structure on columns. The latter type has not been extensively used but there is a wide field for its application.

In the development of expansion joint details the following consideration should be borne in mind. In the arch type with superstructure, expansion joints in the superstructure must provide for movement in both a vertical and horizontal direction—up and down for rise and fall of the arch ring and in a horizontal direction due to elemental changes of length in the various members of the floor system. Where transition for these non-concurrent movements

from one secton to another is attempted in the superstructure by sliding or vertical surfaces in contact, there is the imminent danger of a shearing failure in these sections in contact caused by excess of frictional or torsional action over the strength of the section in shear. The cantilever joint shown in Fig. 1 has been found to circumvent such a failure. The floor beams and slab of a particular span of superstructure are cantilevered from columns or bents to form a clear cut opening at the center of the span, providing free action in either horizontal or vertical direction. Joints placed at the quarter points of the span, approximately at the point of contraflexure in the arch ring, and at the pilasters adjacent to the piers have proved successful for spans of 90 to 200 ft. This arrangement divides the floor system over each arch in three sections and eliminates an extremely large moment in the floor system over the haunch of the arch due to a maximum vertical movement at crown of arch. The amount of moment or tension in the floor system due to vertical movement of the main arch ring varies with the ratio of rise to span; the flat segmental arch causes greater moment than the semi-circular arch of equal span. The principle or effect of the cantilever joint in floor system can be secured in the parapet wall construction of a barrel arch supporting earth fill, by vertical joint through the walls and sidewalk as shown in Fig. 2; here two separate counterforts and cantilever beams take end reactions.

For the second type, the T-beam or rectangular slab design supported on columns or bents, the action to be controlled is in the horizontal direction only. In the T-beam type there arises the difficulty of transferring the movement due to temperature changes from the larger through the smaller members as from the deep beams through the slabs. Regardless of the length of structure the slab should be substantially reinforced in transverse direction to distribute stress or prevent a cumulative strain at change of sections.

For sliding joints, plates of steel, copper, zinc or lead and multiple layers of fabrics or combination of these different plates have been used to reduce friction resistance. Where the bearing covers a wide area there is the danger, if heavy plates are not used, that the sliding medium or plate will conform to a possible uneven surface of a bridge seat and cause a crack. Therefore, great care must be exercised in preparation of the sliding joint, or bridge seat.

The third type, the flat-slab construction, can be built in greater lengths between expansion joints than either of the preceding types. Because of the uniform cross section everywhere of both concrete and steel, the slab offers better resistance to temperature changes, the movement being distributed more uniformly throughout its entire length. Expansion joints in this construction are formed by double row of columns, and have been placed 418 ft. apart in structure over railroad tracks where close lateral clearances precluded double row of columns. A length not exceeding 250 ft. would be better practice.

Construction Joints

Plans should show distinctly the location of possible construction joints. This detail is a decided help to the contractor, enabling a more intelligent analysis of the construction problems and avoids confusion and misunderstanding during the progress of the work. The designer, in arranging the location of these joints, should bear in mind and be able to judge the capacity of plant required commensurate with the magnitude of the work. For example, if a one-yard mixer is sufficient, the average volume of concrete for an 8-hr. operation would be approximately 160 cu.yd., an average of a batch every three minutes. It is possible to exceed this by 40 cu.yd., but operation is without interruption. Therefore, any larger section poured in continuous operation would require overtime or double shift.

The lengths of reinforcing rods should be predetermined so that no excessive length of dangling rods project beyond the construction joint to make the placing of the concrete a very difficult operation. The projecting lengths beyond the bulkhead forming construction joint should be long enough to develop bond strength with the next lift of bars. In beam or slab construction, the joint is placed at point of least shear or maximum moment. No lap of bars should be made at this point unless absolutely necessary; then in addition to the usual lap to develop bond strength the bars should be clamped together by mechanical means.

Construction joints for gravity wall work should not be placed at greater intervals than 30 ft. By addition of temperature steel in reinforced walls, they can be poured with safety in sections 50 ft. in length. Gravity walls should be built preferably in one operation from footing course to the underside of the coping, and this may shorten the length of the section in order that the capacity of the plant is not exceeded. Vertical joints in wall construction are far more desirable than the horizontal joint which usually develops into an unsightly crack by reason of the formation of an efflorescence and gradual surface disintegration in spite of extreme precautions in removal of sludge and cleaning the joint before the subsequent operation. It is good practice to dovetail adjoining vertical sections by form insert and to further seal the joint against percolation of drainage by painting first exposed surface with heavy coat of asphalt. If back fill carries considerable water embed copper flashing in the joint in addition to the above precautions. Before placing the copper strip punch ends to be embedded with holes 2 to 3 in. in diameter to insure good bond. The center of the copper strip should be crimped with 1-in. "V" to allow for movement at the joint.

Avoid placing construction joints at sidewalk level or along plane of extrados of a barrel arch or any other plane where water is liable to be concentrated. In Fig. 1, the coping was carried above the sidewalk level simultaneously with sidewalk construction without measurably increasing the cost of construction. The same figure shows a curb section built with the arch ring. In event of the failure of the waterproofing blanket there is no concentration of water at the construction joint. The figure also shows other construction joints and how the waterproofing membrane was positively flashed and lines of termination sealed by application of waterproofing.

Drainage

The outstanding consideration in detail of drainage of a bridge floor is to lead the water to down-spouts placed at close intervals so that no large amount of water is carried over long distances or no large amount of water led to a single down-spout which would tend to choke up by ice formation in freezing weather. If possible, dikes should be built integrally with the floor slab adjacent to the expansion joint, and the floor ramped away therefrom by grade to down-spouts placed apart from the joint. An objection often given to expansion joints is the difficulty in making them watertight. By effective placement of copper flashing, by carrying membrane continuously over the joint and by further protection of plates, as shown in Fig. 1, the expansion joint can be made absolutely watertight. In sidewalk and coping construction above the floor, copper flashing has been used effectively in the construction joints not fully protected by the membrane seepage followed by slight unsightly surface disintegration.

Avoid placing down-spouts in concrete sections without due regard for the expansion of a metal drain pipe; this consideration has been satisfied by wrapping pipe with several plies of tar paper.

Avoid placing outlet of drain where the drip will pour over a concrete surface or overhead where icicle formation will endanger life. It has been found that formation of icicles can be prevented to a large extent by placing perforated copper baskets filled with rock salt at the top of each drain pipe.

In all retaining wall construction place weep holes at ground level to drain back fill. In case of the back fill carrying unusual amount of water, trench drains have been built up around the weep holes to facilitate free flow of drainage. Special attention should be given to the drainage of U-shaped abutments. There is a tendency in determining the size of weep hole or drains to fix the size by actual amount of water to be carried. These should be made exceptionally large to avoid being clogged by dirt, and if so, that they might readily be cleaned.

Repairing the Rolling Parts of Two Bascule Bridges

Damage to Parts in Rolling Contact Due to Excessive Bearing Pressures Producing Distortion and Crushing of Segmental and Track Girders and Excessive Wear on Tread Castings

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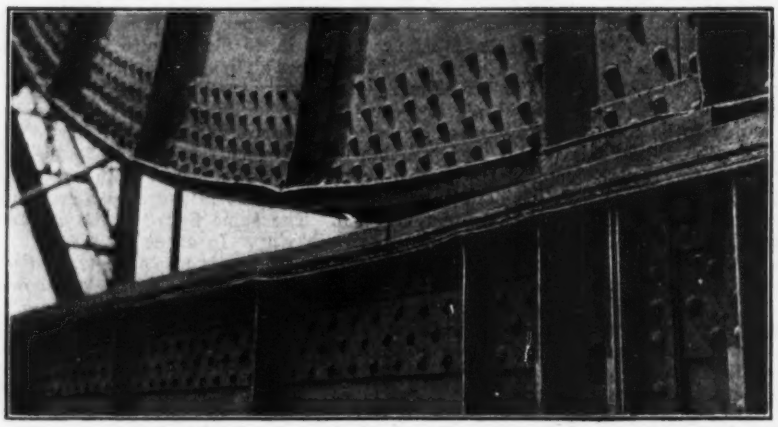
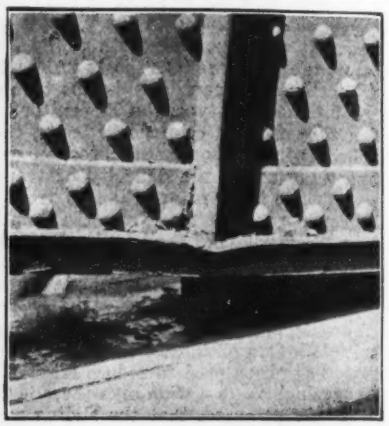
HEAVY repairs have recently been made to two rolling-lift bascule bridges carrying the Cleveland, Cincinnati & St. Louis Ry. across the Cuyahoga River at Cleveland. The repairs were necessary by reason of serious damage to the rolling parts of the bridges that had developed in the course of time. Study of the damage and its relation to the proportioning of the damaged parts indicates quite definitely certain limits that should be observed in the design of members carrying heavy rolling loads if permanent service is to be secured.





FIGS. 1 AND 2. TWO VIEWS OF THE DAMAGED TREADS AND FLANGES OF GIRDERS, BRIDGE 4

The bridges repaired are: Bridge 2, a 120-ft. double-track bascule erected in 1901; and Bridge 4, a 125-ft. single-track span, erected in 1900. They were of an early design, and the defects to be described became evident after a few years' service. In time these defects resulted in such extensive damage that the renewal of some parts and repairs to others were imperative if the bridges were to remain in service.

Description of Damage—The first evidence of distress was the shearing of the bolts connecting the curved tread plates to the segmental girders, followed by the slotting of the bolt holes. This was followed by the cracking and failure of the flange angles in the root, breaking of tread plates and a longitudinal movement of the spans. The stiffeners and diaphragms had cut into the plates, and the webs and flange plates of the segmental and track girders were crushed and broomed to a depth of ½ in. at some points. The tread plates were rolled out and worn.

In the views Figs. 1 and 2 the effect on the flanges of the segmental and track girders is clearly brought out. At the left in Fig. 3 the deformation of the segmental girders is drawn from an actual cross-section. The original sections of the flange and tread plate are shown in light lines and the final sections in heavy lines. Both bridges had been operated more than 50,000 times: the double-track span 53,000 times (in 20 years) and the single-track span 60,000 times (in 21 years' service).

The failure was due, in part, to poor details, but principally to excessive pressures, far too intense for a rolling-lift span. The original and new flange sections for both bridges are given at the bottom in Fig. 3. In Bridge 2 the rolling load per truss was 700,000 lb., which (assuming a longitudinal distribution of 6½ in.) resulted in a bearing pressure between the web plates and tread plates of 14,350 lb. per sq.in. and between the tread plates a pressure per inch width equal to 144 times the diameter of roller. The new section reduced the bearing pressure to 9,000 lb. per sq.in. and 112 D per inch of roller. In Bridge 4, the 125-ft. single-track span, the rolling load per truss was 365,000 lb., resulting in a bearing pressure of 18,250 lb. per sq.in. and a roller bearing per inch width of 156 D. With the new sections the bearing pressure is reduced to 8,300 lb. per sq.in. and the roller bearing to 73 D.

Repair Required—To overcome the defects which had developed it was necessary to renew the tread plates and flanges of the segmental girders on both bridges, the flanges on the track girders of Bridge 4 and the entire track girders of Bridge 2. It was desirable to increase the thickness of the track castings, but at Bridge 4 the thickness was limited by the amount which the grade of the bridge could be raised, and the new castings therefore were made 3½ in. deep. At Bridge 2, the track could not be raised at all, but as the track girder was to be renewed it could be made of slightly less depth; these conditions limited the thickness of the new tread plates to 4⅞ in.

The castings were designed so that the effective tread bearing would come under the web plates only. The top or curved castings had lugs on top, as shown, to tie the old webs together, as it was necessary to cut out the lower part of the old diaphragms. The joints of the bottom castings were cut at an angle, to break joint

with the treads. The castings for the segmental girders were finished straight (to the chords) on the top side to avoid radial planing.

The flange angles and side plates on the segmental girders of both bridges were replaced with new ones of heavier section, and additional stiffeners were provided. The thickness of the new side plates was limited by the small distance between the two webs of the girders, as it was necessary to have clearance between the two inside plates to enter the long rivets from the inside. It was known that the webs were mashed to such an extent that they could not be depended upon to take bearing from the new tread plates; so the radius of the track was increased, to bring the top surface of the tread plates ⅛ in. from the edge of the old web plates.

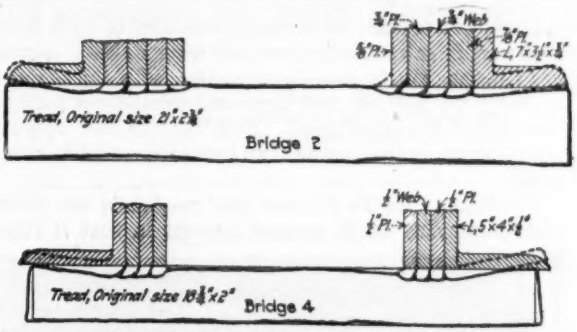
Method Adopted—Bridge 2, the double-track span, is high enough to clear tugs and fire boats, and did not have to be operated during the close of navigation. This permitted the renewal of the entire track girders, which was desirable. It was arranged to support the span, while the track girders were being renewed, on a temporary post riveted to the main end post and gusset plate and carried down to the pier. When the work was started this post was riveted on, just clearing the bridge seat; the span was rolled back, a plate was put under the post, and the span was then rocked forward so that the post came to bearing, lifting the entire span clear of the track girders. It was thus carried as a simple span until the completion of the work.

Bridge 4, the single-track span, is so low that it is opened several times daily even in winter for the passage of small boats. This made it impracticable to renew the track girders outright, and it was arranged to renew the top flange only. The flanges and plates on the back end of the girders could be renewed and still allow the bridge to be partially opened; this done, a temporary splice between the old and new work could be provided, the bridge rolled back past the splice, and the work on the front end completed.

The new steel and castings were furnished by the King Bridge Co., of Cleveland, and all shop work possible was done by them. The old side plates were removed and sent to the shop to be used as templets. It was necessary, however, to sub-punch many of the holes, later to be reamed in the field; also, the outstanding legs of the flange angles were left blank and drilled in the field from the castings.

Field Repairs—The actual placing of the material was done by the Ferro Construction Co., of Chicago. Permission to close the bridges to navigation was not received until Jan. 24, 1921, and the permit required that the bridges be restored to service March 15. Work was at once started on both bridges and a large part of the time three shifts were worked, completing it on time. Great care was used to align the spans and surface the tread plates properly, but no unusual difficulties were encountered. As the work developed, more field work was found necessary than at first anticipated. The main posts were found to be badly crushed at the bottom, and in order to get proper bearing on the new plates it was necessary to cut off about ⅛ in. and resurface them in the field. This was done by a motor-driven grinder mounted on a table moving in two directions, as shown in Fig. 5.

The weight of the new material applied was 350,000 lb., and the total cost was approximately $90,000.



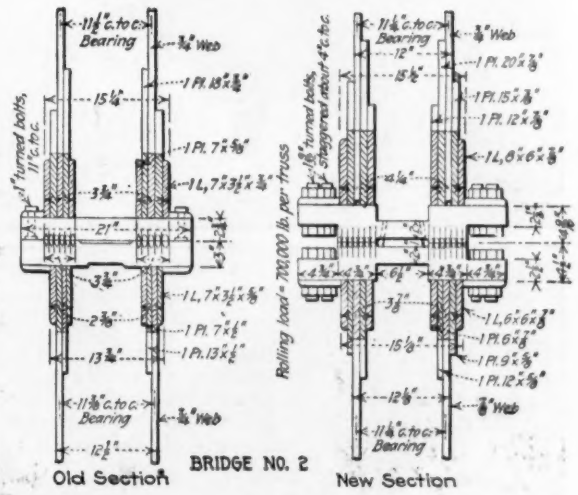


FIG. 3. DISTORTED SEGMENT GIRDERS AND TREADS, AND OLD AND NEW TRACK CONSTRUCTION

If more height had been available the castings would have been made about 8 in. deep to provide better longitudinal distribution of the load, but it was felt that the plates as installed would give satisfactory service during the probable remaining life of the structure as a whole. While great care was taken in bending and finishing the flange angles on these segmental girders in order to insure uniform bearing on the castings, it is difficult to make the bend sharp enough at the chord points to give bearing at the extreme end of the castings. If it were practical to finish the top surface of the upper castings to an arc, it would probably be well to curve these angles.

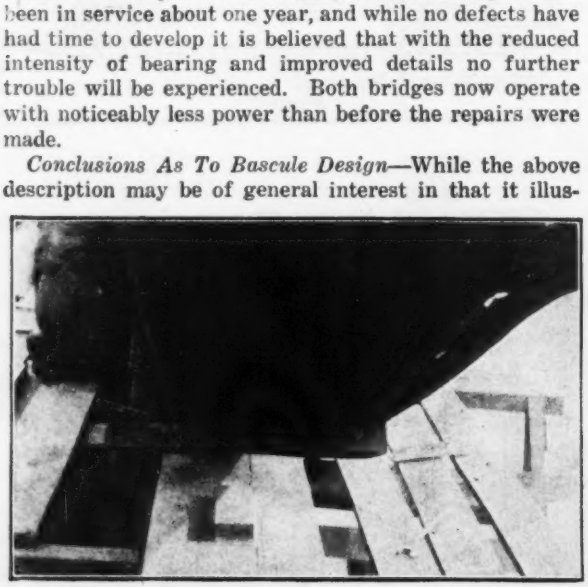
Since the repairs were made, the two bridges have been in service about one year, and while no defects have had time to develop it is believed that with the reduced intensity of bearing and improved details no further trouble will be experienced. Both bridges now operate with noticeably less power than before the repairs were made.

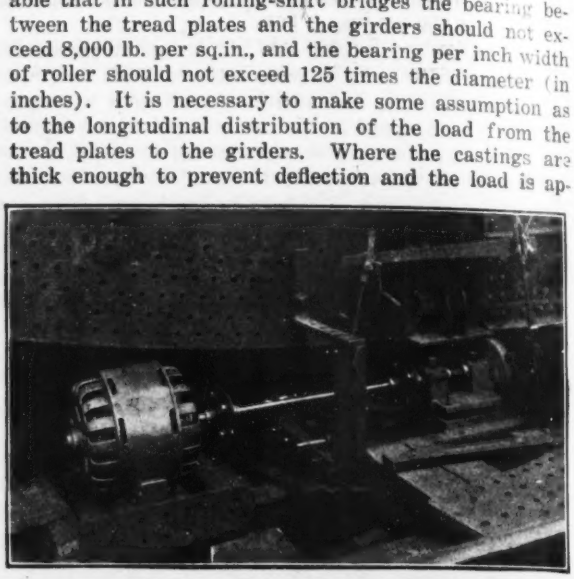
Conclusions As To Bascule Design—While the above description may be of general interest in that it illustrates one method of correcting defects which had reached a very acute stage in two rolling-lift bridges, the cause of the failure and remedies suggested by what was found here which might be applied in new designs are perhaps of greater interest and importance.

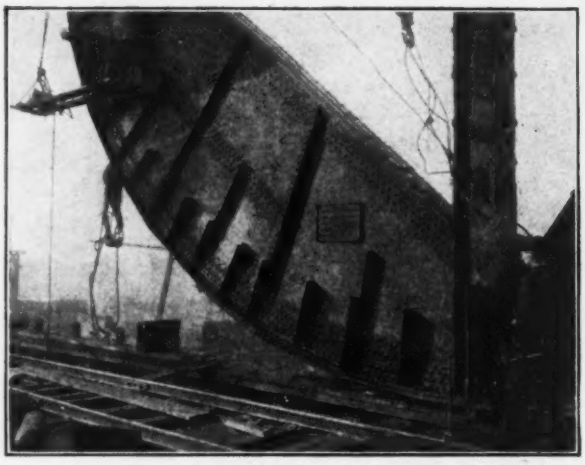
These bridges were of an early design, and among the first of the heavier railroad spans built. The stresses used for bearing and rolling were probably at that time considered conservative. They proved, however, to be far in excess of what should be permitted under such conditions of service. It must be remembered that in such bridges of any great length the load is heavy and is rolling, and almost in line contact under the roller. The metal in the contact surfaces is subject to an action similar (to use a homely illustration) to that on pie dough under the rolling pin, and is rolled out in the same manner, if to a lesser degree. This is clearly shown in the sections of the plates which were removed.

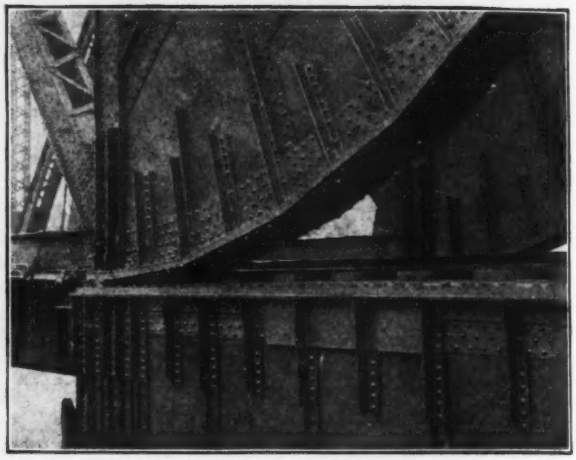
From what occurred at these two bridges, it is probable that in such rolling-shift bridges the bearing between the tread plates and the girders should not exceed 8,000 lb. per sq.in., and the bearing per inch width of roller should not exceed 125 times the diameter (in inches). It is necessary to make some assumption as to the longitudinal distribution of the load from the tread plates to the girders. Where the castings are thick enough to prevent deflection and the load is applied near the center of a tread section, it would be reasonable to assume a distribution along the line of shear or for a length equal approximately to twice the depth of the casting.

When the load is applied just at the end of a tread section the longitudinal distribution would be reduced about one-half if the castings were absolutely fixed in reference to the girder, but under actual conditions the intensity of bearing at the end of the section probably is considerably greater than the average. This is particularly true with shallow castings, and the old girders removed showed clearly where the ends of the sections had cut into the webs and plates of the girders. On some of the recent bridges of this type the castings have been forked at the ends to provide a partially continuous bearing over the joints, but with perfect workmanship only 50 per cent of the load could be assumed as carried over the joint into the next section. To provide for this critical condition at the ends of the sec-









FIGS. 4 TO 7. DAMAGED TRACK OF ROLLING-LIFT BASCULES AND ITS REPAIR

Above: Fig. 4. Crushing of webs, failure of flange angles and cutting of tread castings, Bridge 4

Above: Fig. 5. Grinding bottom of main post where severe crushing had destroyed the bearing, Bridge 2

Below: Fig. 6. Fitting new flange to segment girder, Bridge 2; new track girder already in place

Below: Bridge 4 after completion of repairs; new track castings and flanges and extra stiffeners

tions of the tread plates, it would seem better to assume a longitudinal distribution approximately equal to the depth of the castings. This would not result in abnormal sections, as for example, with 2,000,000 lb. rolling load per truss and the castings 20 in. deep a total width of bearing of 12½ in. would be required, or 6¼ in. for each side of the girder. The bearing width of the tread plates, assuming a segmental girder radius of 30 ft., and based on 125 D, would be 22 in., which is practicable.

Modern bridges of this type show modifications designed to overcome some of the difficulties as experienced with the two bridges whose repair has been described. In designing that portion of the structure which takes the rolling load (that is, the girders and tread plate) for new bridges and where possible for the repair of old bridges, the following points might well be given consideration as governing requirements:

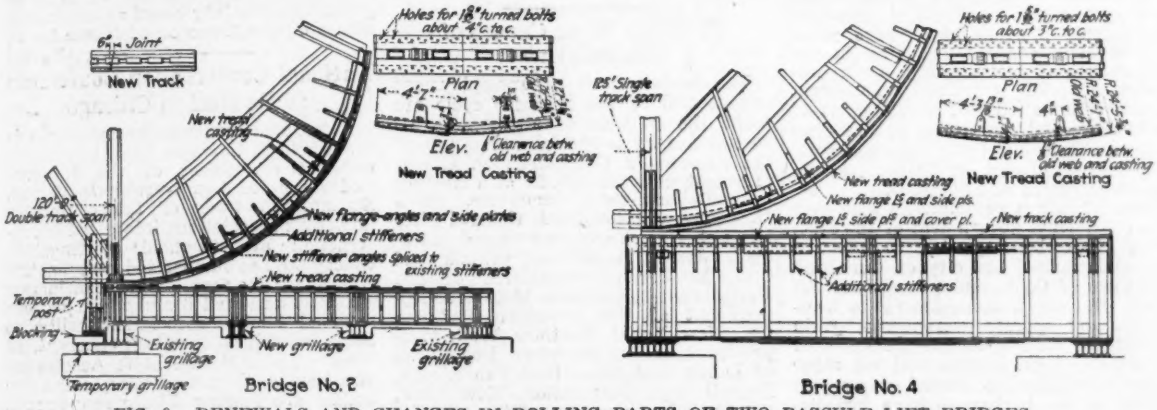


FIG. 8. RENEWALS AND CHANGES IN ROLLING PARTS OF TWO BASCULE LIFT BRIDGES

(1) Low bearing stresses (as compared with practice in fixed spans) at the contact surface between the tread plates and girders and between the tread plates;

(2) Symmetrical arrangement of side plates of the girder flanges about the center of the web, and placing the center of the webs of the segmental girders in line with center of the webs of the track girders;

(3) Deep tread castings (probably not less than 8 in. for light rolling loads, so rigidly attached to the girders as to prevent rocking and longitudinal movement, so designed that the bearing surfaces between the upper and lower castings will be symmetrical about and directly below or above the webs of the girders, and of such section that no bearing will be imposed upon the outstanding legs of the flange angles.

Uniflow Engines Drive Centrifugal Pumps

To fill the Littleton storage reservoir of the London Metropolitan Water Board, England, from the River Thames, uniflow engines and centrifugal pumps will be used. There will be four pumping units, each with a capacity of 75 Imp. m.g.d., working against a head of 37 ft. and delivering water through three 72-in. steel force mains laid over the reservoir embankment. The engines which are designed for a 25 per cent overload, will have a total pump horsepower of 3,120. The pumping plant is being built by Worthington-Simpson, Ltd., London, England. The Littleton reservoir, now under construction will have a capacity of 6½ billion Imp. gal.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Need for National Standard in Motor-Vehicle Legislation

Sir—The writer desires to endorse the idea in the Feb. 2 issue of *Engineering News-Record*, p. 178, with reference to the advisability of establishing definite weight and speed standards for motor vehicles by some national authority. We must design our roads to carry greater weight than we have used in the past, and in the design of roads we should adopt definite standards of weight and speed of vehicles. Otherwise, the designs of different engineers are bound to vary greatly, with a consequent variation in the amount and character of the service which the highway will be able to render.

If such standards are not nationally established, how else can they be established? With the advent of motor haulage the sphere of action of the vehicle has been transferred from local and urban traffic to intercounty and interstate traffic. It is certainly an unfortunate condition which compels the owner of a vehicle engaged in such interstate traffic to study the laws of each state through which he must travel.

We note in the daily papers an agitation that cities shall, in order to preserve their roadways, establish standards of weight and speed for motor vehicles. I consider such an idea as extremely irrational and unfortunate; not only should road rules be uniform within the state, but they should be uniform throughout the country.

Carrying the idea further, the writer desires to begin the agitation of another subject along related lines. Why should we not have a nationally adopted system of highway sign posts, guide posts and signals? The present system, at least in Pennsylvania, is an abomination. The state highway department has its own standards and each county has different standards, depending on the whim of its county road authorities.

The driver of a motor vehicle going along the road with his attention concentrated on the traffic conditions cannot derive the same benefit and instruction from these varying signs that he would if a uniform system of signs were used. There are the same reasons for such a uniform system as there are for the present uniform system of railroad signals.

Pittsburgh, Pa. LOUIS P. BLUM,
Feb. 12. Blum, Weldin & Co.,
Engineers and Surveyors.

NEWS OF THE WEEK

New York, March 9, 1922

Outlines Broad Project to Develop Cork Harbor

Comprehensive Plan Aims to Establish Cork as Foremost National Port of Irish Free State

Plans looking to the establishment of Cork Harbor as a national port of the Irish Free State have been submitted to the harbor commissioners by George F. Nicholson of Seattle, consulting engineer to the board.

The plans include the construction of a new pier, including a warehouse, cold storage plant, grain elevator, railway yards and mechanical handling equipment; a groin to increase scour in the main channel, dredging in the main channel and turning basin, improvement of existing water-front plant, reclamation and development of tidal flats, and completion of dredging between Cork and Cobh (Queenstown). The estimated cost of these improvements is placed at £2,000,000.

Mr. Nicholson recommends also that the provisional government of the Irish Free State be requested to effect a consolidation of the city of Cork and the town of Cobh, and to empower the Cork Harbor Commissioners to construct and operate warehouses, grain elevators, cold storage plants, coal terminals, tugs, barges and all other harbor facilities, to control ship-repair plants in the harbor, to have jurisdiction over water-front streets, to acquire, or at least to control, water-front railway trackage and to establish a lease period for terminal properties of 30 years subject to reappraisement every five years.

In submitting his report, Mr. Nicholson suggested that the provisional government be requested to appoint a commission of three outside experts to investigate and report to the government as to all the Irish ports in order to provide for intelligent development that will meet most effectively and economically the national commercial needs of the Free State.

New Engineering Company to Operate in Mexico

The J. G. White Engineering Corp. and the Raymond Concrete Pile Co. have announced the formation of the Raymond-White Co. to engage as engineers and contractors in Mexico. The company's office in Mexico City was opened March 1 under the direction of S. Bradshaw Jacobs, vice-president in charge of Mexican operations.

Consider $500,000 Bond Issue for Rhode Island Bridges

The General Assembly of Rhode Island has referred to the House finance committee a resolution calling for a $500,000 bond issue for the construction of highway bridges. If approved by the legislature, the project will be submitted for ratification by popular vote at next November's election.

Machinery Corporation Gets Large Brazilian Contract

Robert Morris, head of the Austin Machinery Corp. of Louisiana, recently closed a deal with the Brazilian Government whereby his company will furnish about $4,000,000 worth of machinery for use in public improvements in Sao Paolo, Brazil. It is possible that in view of the extensive public improvements proposed for Brazil the Austin company will secure further contracts. In such an event it is probable that a branch office will be established either in Sao Paolo or Rio.

To Study Basic Causes of Unemployment

The fundamentals of unemployment and control of the business cycle are to be the subjects of a thorough investigation by a special committee of the President's Conference on Unemployment, selected Feb. 20 at a meeting in the Department of Commerce. Owen D. Young, vice-president, General Electric Co., New York, was named chairman. Joseph H. Defrees, president of the Chamber of Commerce of the United States, Clarence Mott Woolley, president of the American Radiator Co., New York; Matthew Woll, vice-president of the American Federation of Labor; and Miss Mary Van Kleeck, Russell Sage Foundation, New York, are the other members of the committee. Edward Eyre Hunt, secretary of the President's Conference on Unemployment was appointed secretary of the new committee, and Wesley C. Mitchell of New York, field director of the investigation.

The committee is to report to the President's Conference on Unemployment and the public in about six months.

Am. Soc. C. E. Acts on Amendments

Ballots on six proposed amendments to its constitution were canvassed by the American Society of Civil Engineers at the meeting in New York City March 1, resulting in the adoption of those three amendments which had been sent out with a recommendation in favor of their adoption and the defeat of the other three. In each case the vote was decisive.

The three amendments which were passed by substantial majorities covered: Change of the membership grade of "associate" to "affiliate"; dues for members residing outside of North America; and voting by zones or districts for vice-presidents and directors.

The defeated amendments included one on a proposed plan of electing officers by local section representation; provision for an annual conference of representatives of local sections to consider the welfare of the society; and the establishment of local sections in each geographical district of the society and compulsory membership in a local section.

To Oppose Water-Rate Increase by East Jersey Water Co.

A committee of mayors of New Jersey cities and towns in the district supplied by the East Jersey, Passaic, Montclair, and allied water companies has engaged Cylde Potts, consulting engineer, New York City, and John Milton, formerly city attorney of Jersey City, to contest the proposed new schedule of water rates filed by the companies with the New Jersey Board of Public Utilities. H. F. McConnell, mayor of Montclair, is chairman of the mayor's committee. A public hearing is to be given by the utility board at its Newark offices on the forenoon of March 29.

National Construction Conference to Be Held in Chicago

A national construction conference is to be held in Chicago, April 3, 4 and 5, under the auspices of the National Federation of Construction Industries. During the week of the conference numerous associations interested in construction are to hold meetings in Chicago. The lumber industry has arranged for the fourth American lumber congress on April 6 and 7 and various national lumber associations will also hold individual meetings during the week. The National Lime Association will hold a district meeting and other bodies are making like arrangements.

Water-Supply Material Men Get Recognition

At the final meeting of the season of the New York Section of the American Water-Works Association, March 2, in New York City, Beekman C. Little, superintendent of water-works, Rochester, N. Y., advocated the giving of greater recognition to the associate members of the association. He pointed out that the equipment and material men had contributed much to progress in the water-works field by research work along various lines designed to improve materials and machinery. Among the instances mentioned was the co-operation of the meter manufacturers in the standardization of water meters. While on the subject of meters Mr. Little remarked that a water meter sold to the city of Rochester 32 years ago by the late John C. Tully was still in use.

Frank T. Kimball, secretary, New Rochelle Water Co., New Rochelle, N. Y., was elected as governor of the section to succeed Col. George A. Johnson.

Johns Hopkins School of Public Health Receives $6,000,000

To place the Johns Hopkins School of Hygiene and Public Health on a solid financial basis the Rockefeller Foundation, New York City, has given the school $6,000,000. Money will be used partly as an endowment fund and partly for buildings adjacent to the Johns Hopkins Medical School and Hospital.

Detroit Engineering Societies Form Federation

After several years of discussion as to the advisability of establishing a central association, engineers, architects, chemists and other technical men of Detroit have formed a federation. A federation of twelve societies was effected Jan. 1 by the ratification of a constitution and by-laws, acceptance of membership of the various societies, and the election of counselors by the following twelve bodies: Detroit Section, American Society of Civil Engineers; Detroit Chapter, American Association of Engineers; Michigan Chapter, American Society of Heating and Ventilating Engineers; Detroit Post, Society of American Military Engineers; Detroit Section, American Society of Mechanical Engineers; Detroit-Ann Arbor Section, American Institute of Electrical Engineers; American Institute of Chemical Engineers, Detroit Engineering Society, American Chemical Society and Detroit Chemists; Michigan Chapter, American Institute of Architects; Detroit Section, Michigan Society of Architects; and the Detroit Chapter of the American Society for Steel Treating.

The permanent council has elected the following officers for 1922: Chairman, P. W. Keating; vice-chairman, A. A. Meyer; secretary-treasurer, Walter R. Meier.

The federation will take an active interest in all matters wherein engineering, architectural and technical subjects are important factors. The council will study the opinions of the membership and will assist in furnishing definite and accurate information to the public. The federation will offer its assistance and advice to city and state officials whenever required. The aim and purpose of these activities will be the provision of the most reliable technical information for the proper consideration of public improvements and public undertakings in which all Detroit citizens are interested.

Louisiana Building Contract Commission Appointed

The Legislature of Louisiana at the recent extraordinary session passed a law creating a building contract commission and clothed Governor John M. Parker with authority to appoint the five members who were to compose it. Announcement has just been made of these appointees.

W. O. Hart, a prominent attorney of this city, is made chairman, with the following associates: T. J. Grier, of Shreveport, president of the State Federation of Labor; George J. Glover, of New Orleans, builder and contractor; W. W. Carre, of New Orleans, lumber dealer, and W. B. Connell, of Baton Rouge, banker.

The purpose of the commission, whose members serve without compensation, is to investigate all bonds and codal provisions bearing on building contracts in this state, contractors' bonds and laborers' and material men's liens and privileges.

It is also the intention to make a study of similar legislation in other states and to give interested individuals an opportunity of presenting their views. A report on the subjects so investigated will then be made by the commission to the legislature during the first week of the next regular session in 1922.

Employment Among Engineers in the New York District

Little improvement since Jan. 1 in the unemployment situation is reported by the Employment Service of the American Engineering Council of the Federated American Engineering Societies. The total number of men registered by the service, which is located in the Engineering Societies' Building, New York City, up to January was 3,209. This included those out of work or who were filling temporary jobs. During January 142 new registrations were received and 131 men obtained jobs. The number of positions filled was 186. An average of eight jobs filled per day is being maintained. Most of the unemployed engineers are college or technical school graduates and some have earned salaries as high as $15,000 per year.

Marine Borers and Their Work Shown in Exhibit

The Committee on Marine Piling Investigations of the National Research Council, in preparation for a meeting to be held by the Municipal Engineers of the City of New York in the Engineering Societies' Building on March 22, has collected a large number of specimens of marine borers and their work. These specimens represent a number of species of borers and are from various locations on the Atlantic, Gulf and Pacific coasts. These specimens have been placed in the lobby of the Engineering Societies' Building for the inspection of all who are interested.

The committee, of which Col. W. G. Atwood is director, feels that the recent discovery in Barnegat Bay, N. J., of the same species of teredo which did such great damage in San Francisco, makes the study which it is initiating of extreme importance in New York and other Eastern harbors. This species, the Teredo Navalis, has not been identified on the Atlantic Coast previously. It is by far the most destructive of the various species.

Zoning and Traffic To Be Taken Up at Indianapolis

Zoning and traffic problems will be considered early this year by the City Planning Commission of Indianapolis and consultants engaged. Lawrence V. Sheridan is executive secretary of the commission.

Tax Exemption of New Dwellings Upset in New Jersey

The New Jersey statute of 1920 authorizing exemption from taxes for five years of new dwellings erected during the year ending Oct. 1, 1922, has been declared unconstitutional by the State Supreme Court (Julius Koch against Essex County Board of Tax Equalization). The court holds that the exemption of new dwellings violates the constitutional provision that all property must be assessed for taxation under general laws and uniform rules, according to its time value. Reversal of the opinion by the Court of Error and Appeals is a possibility but is not considered likely.

Wisconsin Societies Plan Registration Co-operation

Engineers Urge Passage of Bill—Other Matters Discussed at Society Meeting in Madison

Registration of engineers in Wisconsin was approved by the Engineering Society of Wisconsin at its meeting Feb. 24 and 25 at Madison. For this purpose and for other engineering problems of state-wide interest the organization voted to co-operate with other technical societies. Affiliation with other organizations in the state is to be studied by a committee. Consideration of joining the Federation of American Engineering Societies was put over for another year. In urging registration P. H. Connolly, chairman of a committee which brought in a new draft of the bill, which failed to pass at the last session of the legislature, stated that Wisconsin was surrounded by states which had such laws. In consequence the incompetents could practice in Wisconsin while the competent consultants of Wisconsin were under a handicap when they sought business in other states. Although the legislature does not meet until next winter, the secretary was instructed to name engineers in the various political sub-divisions to make the acquaintance of every legislator and if possible secure his support of the bill.

Attendance Was 250

The society is in flourishing condition, having increased its membership from 50 five years ago to 210 now. About 250 engineers and guests attended the dinner-meeting which was given jointly with the Technical Club of Madison. Daniel W. Mead, consulting engineer, Madison, addressed this meeting on "Engineer Ethics" which he interpreted tersely by the term "square deal." A committee was authorized to draw up a code of ethics.

Following a plea for funds for the Land Marks Commission by J. G. D. Mack, state engineer, $50 was appropriated in connection with a marker of the site of the first electric-light installation at Appleton in August, 1882.

Of technical interest to the civil engineer were papers on roads, land drainage and bridge construction.

A. R. Hirst, chief engineer, Wisconsin Highway Commission, outlined the state's 1922 road program.

A general discussion on specifications was precipitated by Prof. E. R. Jones of the University department of agricultural engineering. A committee on drainage was authorized to study drainage contracts and specifications and to submit approved forms next year.

The society urged the enactment of a law whereby plats showing drainage and other surveys may be recorded for the benefit of the land owner as only county surveyors can now record results of surveys.

L. J. Klug, consulting engineer, Milwaukee, described the methods used in the construction of the 1,385-ft. North Avenue reinforced-concrete arch bridge in Milwaukee. Speed was essential because of a threatened $200,000 suit by ice companies which were apprehensive that the lowered water level carried behind a dam below the bridge would interfere with their ice harvest. To expedite progress on the piers all form timber was designed in the drafting

room, cut in the shop and each piece numbered. It was stored on the old bridge above the piers and quickly dropped into place with a minimum of carpenter work as soon as the excavation was completed. The two ribs of each of the three main arches were cast separately over structural steel trusses fabricated on the job. After a setting period of 28 days forms under the first set of arches were struck. It required only 10 hours to lower the trusses roll them transversely and jack them to position ready for the concrete for the second set of ribs.

The officers elected for the ensuing year are as follows: President, Jerry Donohue; vice-president, John C. White; new trustees, C. I. Corp and A. L. Hillis; secretary-treasurer, Leonard S. Smith, Madison.

Vanderbilt University to Build Stadium

Vanderbilt University, Nashville, Tenn., has through the co-operation and assistance of the Alumni Association and the Nashville Chamber of Commerce, raised $150,000 for the erection of a concrete stadium. Freeland, Roberts and Acker, Nashville, have been selected as designing engineers, and Hart and Nevins, also a Nashville firm, will take care of the architectural features of the project. Construction is expected to start this spring. It is hoped that the structure will be completed in time for the opening of the football season.

New Railroad Valuations Announced

Additional tentative valuation of common carrier properties, as of June 30, 1916, have been handed down recently by the Interstate Commerce Commission.

Name of Road	Final Value	Cost of Reproduction New	Cost of Reproduction Less depreciation	Liabilities (Capital Stock plus Long term debt)
Boston Terminal Company	$19,910,500	$6,527,116	$5,224,722	$15,000,000.00
Chicago, Indianapolis & Louisville Ry. Co.	27,270,223	9,654,015	7,841,230	33,710,930.00
Indianapolis & Louisville Ry. Co.	1,900,000	2,033,367	1,748,523	1,939,902.73
Charleston & Western Carolina Ry. Co.	10,402,096	9,814,315	7,469,440	6,900,000.00
New York, Philadelphia & Norfolk R. R. Co.	10,976,927	11,465,512	8,549,839	6,800,000.00
Nelson & Albemarle Ry. Co.	141,825	150,172	123,113	385,000.00
New York, Ontario and Western Ry. Co.	34,495,193	37,481,743	28,902,147	88,245,982.84
Louisville & Jeffersonville Bridge Co.	2,977,210	2,371,227	1,630,139	5,925,000.00
Rock Island-Frisco Terminal Ry. Co.	2,006,781	589,868	499,189	3,890,000.00
Southern Illinois & Missouri Bridge Co.	3,182,660	3,374,016	2,968,974	3,270,045.67
Ulster & Delaware Railroad Co.	6,468,019	6,825,669	5,536,780	4,900,000.00
Sandy River & Rangeley Lakes, Railroad	1,359,427	1,585,417	1,242,202	1,177,000.00
New Mexico Central R. R. Co.	1,365,024	1,621,448	1,271,082	8,250,000.00
Southern Ry. in Mississippi	4,470,534	5,276,956	3,740,805	886,148.76
Indiana Stone Railroad Co.	550,000	579,604	519,919	431,909.40
Little Rock, Maumelle & Western R. R. Co.	300,530	307,975	249,816	391,493.57
Rhode Island Company	310,000	369,816	251,508	203,800.00
Pecos Valley Southern Ry. Co.	373,409	420,356	312,238	445,000.00
Norwood & St. Lawrence R. R. Co.	533,078	573,369	466,528	446,000.00
Norfolk and Portsmouth Belt Line	971,831	895,663	668,146	486,308.51
Chesapeake Western Railway	343,837	380,303	306,628	2,838,600.00
Baltimore & Sparrows Point R. R. Co.	349,237	317,369	229,997	150,000.00
East Jersey Terminal Co.	359,390	434,704	332,025	257,000.00
Paris & Mt. Pleasant R. R. Co	813,771	797,589	625,666	675,000.00
Sault Ste. Marie Bridge Co.	500,750	564,811	435,378	1,856,969.31
Artesian Belt Railroad	443,281	492,452	387,562	70,000.00
Rome and Clinton Railroad Co.	405,000	442,692	367,796	345,360.00
Utica, Clinton & Binghamton R. R. Co.	1,275,000	1,341,073	1,089,312	1,649,224.00
Wharton Valley Ry. Co.	200,000	232,352	186,304	145,000.00
Ontario, Carbondale & Scranton Ry. Co.	6,250,000	6,047,536	5,187,957	3,000,000.00
Pecksport Connecting Ry. Co.	100,000	108,092	87,789	80,060.50
Ellenville & Kingston R. R. Co.	900,000	994,637	765,533	950,000.00
Port Jervis & Summitville R. R. Co.	875,000	1,031,208	842,128	560,000.00
Central Union Depot & Ry. Co. of Cincinnati	670,808	704,947	513,023	962,500.00
Butler County R. R. Co.	907,490	1,022,852	831,022	355,000.00
Tuckerton R. R. Co.	503,946	577,244	458,391	652,241.54
Durham & South Carolina R. R. Co.	460,796	544,430	426,213	800,000.00
Rosslyn Connecting R. R. Co.	230,000	108,924	85,188	149,118.15
Augusta Union Station Co.	193,649	150,400	129,268	300,000.00
Angola Transfer Co.	160,000	186,161	149,514	75,000.00
Cape Charles R. R. Co.	143,412	114,670	84,816	131,000.00
Pickens R. R. Co.	126,426	131,325	103,798	115,000.00
Virginia Southern R. R. Co.	127,551	148,264	119,938	43,000.00
Ft. Worth Union Station Co.	210,230	89,122	69,207	91,866.05
Waupaca-Green Bay Ry.	114,201	123,530	100,652	130,400.00

American Association Employment Report for January

Applications for employment to the American Association of Engineers in January numbered 1,872. A year ago they were 2,192 and in December, 1921, they numbered 1,877. Of the January figure the Chicago office received 170, New York and New Jersey 100, Los Angeles 100 and northern California 140.

Positions received were 323 in January, 652 a year ago and 308 in December, 1921. Men referred numbered 156 in January, 274 one year ago and 175 in December, 1921.

Gets Option on Spruce Railroad

E. S. Grammer, Seattle, head of the Admiralty Logging Co., has been granted an option for the purchase of the U. S. Spruce Production Corporation's railroad, built during the war on the Olympic Peninsula; he expects to close the option and take over the property within the next month or six weeks. The option also covers the big sawmill that the spruce corporation built at Port Angles to be operated in connection with the railroad. The purchase price agreed upon has not been made public, but it is stated that negotiations have been based upon a price of $1,500,000 for both properties.

The government railroad, known among lumbermen as the "spruce railroad" is 36 miles long, and is estimated to have cost the government about $4,000,000. It has never been operated except to transport construction materials. The saw mill was about 90 per cent completed when the armistice came, and much of the machinery and equipment is at Vancouver, Wash. It is estimated to have cost the government approximately $1,200,000, and was planned to cut 400,000 ft. in 8 hr.

Seawall and Boulevard Project Planned at Tampa

Four miles of boulevard, bordering on Hillsborough Bay, is almost sure to be an aftermath of the recent storm that struck Tampa, Fla., washing away a part of the brick pavement that composed the highway to Ballast Point Park. The work includes a seawall, a fill, a parkway, two 8-ft. sidewalks and two 24-ft. roadways. It is planned to issue $3,000,000 in county bonds for this work and 54 miles of pavement in other sections of the county.

The project, first urged by the Board of Trade in Tampa has been endorsed by every civic organization in the county and the county commissioners have tentatively promised to permit the county to vote on the bonds for the project some time this month. J. J. Hedrick is the county engineer and has prepared the preliminary plans.

The city of Tampa already has a 40-ft. boulevard drive with two 8-ft. sidewalks and a concrete seawall for two miles of the way within the city limits.

Pamphlets on Engineering Subjects Available

At different times *Engineering News-Record* has prepared for distribution reprints of certain classes of articles. There are in stock several hundred copies of each of these pamphlets, substantially bound in stiff-board covers. Since they have value in the right hands, *Engineering News-Record* will be glad to send copies to its readers, as long as the supplies last, on receipt of 25c. per copy in stamps to cover postage and handling charges.

The pamphlets available are:

Building Subways in New York—A series of articles printed in 1915 and written by Fred Lavis from studies made especially for *Engineering News*. It covers the details of the design and construction of the New York subways, and contains data regarding the organization and personnel of the engineering staff. Included, also, is a description of the design of the new elevated railway structures of the New York Rapid Transit System, written by Maurice E. Griest, former assistant designing engineer of the Public Service Commission. The pamphlet contains 13 pages, is 9 x 12 in. in size, and is well illustrated.

American Engineers Behind the Battle Lines in France—A series of nineteen articles (reprinted in 1918) upon the operations of American engineer units in France, written by Robert K. Tomlin, Jr., associate editor, and former war correspondent of *Engineering News-Record*. This pamphlet should be a valuable addition to the library of any one who served in the American Expeditionary Forces. It is 9 x 12 in. in size and contains 91 well-illustrated pages.

The Engineer in Field and Office—A collection of short-cuts culled from practically every branch of civil engineering, presented in short articles or notes. The 164 pages of text and illustrations cover fourteen groups of subjects. The articles in each group stress design and construction equally. In the highway engineering group, for example, there are nineteen separate items. The pamphlet measures 6 x 9 in. and was published in 1918.

Plan Drainage Program in Texas

A movement is under way to form a permanent organization and prepare a permanent program for the drainage and improvement of the coastal counties of Texas. A meeting of all interested parties was held in Houston, Texas, Feb. 8 and 9 at which L. A. Jones, senior drainage engineer, represented the Public Roads Bureau. The Association plans to ask the cooperation of the department in studying the situation and preparing a plan for development.

Engineering Council Executive Board to Meet in Chicago

The Executive Board of the Engineering Council, Federated American Engineering Societies, will hold a meeting at the headquarters of the Western Society of Engineers, Chicago, March 10. A wide range of subjects will be discussed, embracing both technical and public service matters. Dean Mortimer E. Cooley, of the University of Michigan, president of the council, will preside.

In the evening the Michigan Engineers Club of Chicago will give a dinner in honor of Dean Cooley and President Marion Le Roy Burton, at which function the members of the Executive Board of the Council will be guests.

New York Ship Canal Again Projected

A bill has been introduced into the House of Representatives by Representative Reed of New York to incorporate the Lakes-to-Hudson Ship Canal Co., which grants to Millard F. Bowen and his associates the rights in a corporation which is to build and operate a canal cut around Niagara on the American side between Lake Erie and Lake Ontario, starting again just east of Oswego, down to the Hudson River just south of Albany. The company is to have all the water rights on the canal to the extent of the use of 26,000 sec.ft. of water.

Propose Bridge to Shorten Ferry Trip on San Francisco Bay

The San Francisco & Oakland Terminal Rys. has made application to heads of the departments of war, commerce and the navy, at Washington, D. C., for permission to extend its East Bay terminus to Goat Island. This, it is stated, would shorten the water trip by 1¼ miles and would reduce the time on the ferry from 20 to 10 min. The company would be willing, it is stated, to to build whatever type of bridge government authorities require and in addition to the rail lines would provide a roadway to make the Goat Island terminal accessible to vehicular traffic.

The present fill would be extended as far as practicable and the terminal on the island would be built on the north side where there are shoal waters that could readily be reclaimed for terminal purposes. The application expresses a willingness either to finance the entire project or to join with other transportation companies in a joint terminal program. The plan is, in principle, the same as that suggested by Admiral J. L. Jayne, formerly stationed at San Francisco as commandant of the Twelfth Naval District.

Zoning Integrity Upheld by Court in New York City

The Appellate Division of the New York Supreme Court has upheld the decision of a Supreme Court judge favorable to the effort of J. P. Morgan and other property owners to prevent the putting up of a seven-story office building on a portion of Madison Ave., New York City, that had been placed in the residence district by the Board of Estimate and Apportionment, which is the zoning authority of New York City. Both courts held that the City Board of Appeals had encroached upon the authority of the Board of Estimate in granting the Astor Estate a permit for a business block. It is expected that the case will be carried to the Court of Appeals of New York State.

New Orleans Engineers Organize

Engineers of New Orleans have organized an engineers' club, the purpose of which is the development of a fraternal spirit among engineers of the vicinity through the medium of luncheon-meetings. The meetings are to be held on the third Monday of each month. At the first meeting in February there were sixty-five members present representing the following societies: American Society of Civil Engineers, Louisiana Engineering Society, American Society of Mechanical Engineers, American Chemical Society, and the American Association of Engineers. The following officers were elected: president, Ole L. Olsen; vice-president; J. F. Coleman; secretary, F. A. Muth; and treasurer, J. F. Villavasso.

Two Lumber Companies Build Railroads in California

Two standard-gage railroads are now being built in California for lumber companies; one 18 mi. long in northern California for the Hutchinson Lumber Co. and the other 55 mi. long in the Southern end of the San Joaquin Valley under the name of the "Minarets and Western R. R." The former extends from a junction with the Western Pacific R. R. at Bidwell up a fork of the Feather River through very rough country. On part of the line the cost of the grading is reported to have amounted to $140,000 per mile. The main crossing of the Feather River is to be effected by a 120-ft. girder span. The falsework for this bridge is in place and will be used to support the track until the steel is placed. Grading on the entire line is practically completed and about 5 mi. of the track has been laid. An 18-mi. extension of this same line is pending. W. A. Bechtel of San Francisco is the contractor.

The other railroad leaves the San Joaquin & Eastern R. R. at Friant, crosses the San Joaquin River and extends along that stream for some 55 mi. Of this, 35 mi. is to be operated as a common carrier and 20 m. as a logging railroad. The river crossing is made up of a trestle approach, several girder spans totaling 190 ft. in length, and a 150-ft. truss. The bridge is under contract to the Mercer-Fraser Co. of Eureka, Cal., and is to be completed by next June. The entire line is to be finished within a year. The rails for this line, varying from 60 to 75 lb. in weight, have been purchased from a Belgian steel company.

Want More Money for Mississippi

It having become evident that the $45,000,000 authorized for flood control on the lower Mississippi will not be sufficient to bring the entire levee line up to the standard prescribed by the Corps of Engineers, an effort now is being made by the senators and representatives from the Mississippi Valley to secure legislation to authorize an additional sum for that purpose. Due to the increase in the cost of labor and materials after the $45,000,000 was authorized in 1916 the money which was expended has not gone as far as had been estimated. Nevertheless a great deal of work has been done and the weakest point in the whole levee line in the lower Mississippi Valley is stronger than the strongest point in 1912.

Co-operation Asked in Studying Winter Cholera Outbreaks

An inquiry into the nature and causes of so-called "winter cholera" or "intestinal influenza" ascribed to polluted water supplies is planned by the laboratory of the Department of Hygiene and Bacteriology of the University of Chicago. Dr. J. C. Geiger, of the U. S. Public Health Service, has been detailed to the laboratory named to co-operate with Dr. Edwin O. Jordan in the investigation. Owing to the brief course of these outbreaks the earliest possible notice of any such occurrence is needed for this investigation. Consequently Prof. Jordan requests water-works officials and others in a position to know of these outbreaks to wire him a notification as soon as possible at his expense.

Lock-Bar Pipe To Be Fabricated in Pittsburgh District

The East Jersey Pipe Co. has entered into an agreement with the Riter-Conley Co., whereby "Lock-Bar" steel pipe, which has been exclusively controlled by the former company since its introduction into this country in 1905, will hereafter be fabricated in the Pittsburgh district by the Riter-Conley Co. The sale of "Lock-Bar" pipe will continue to be exclusively in the hands of the East Jersey Pipe Co.

Flood Damage Held to Be "Act of God"

On the theory that the flood that swept through the Stuck-Puyallup Valley, between Tacoma and Puyallup, Wash., in December, 1917, was an "act of God" and not attributable to the negligence of man, a jury in the Superior Court in Tacoma recently returned a unanimous verdict in favor of King and Pierce counties in a suit for $60,000 damages brought by Henry Condor as receiver for the Tacoma Meat Co. The receiver asked damages on the ground that the company's loss, when its buildings were swept away, was the result of negligence and carelessness on the part of those engaged on the inter-county improvement project, then being carried forward on the lower Puyallup River. Engineering experts for the two counties were R. H. Thomson, W. H. Nelson, W. J. Roberts.

Am. Soc. C. E. to Discuss Many Phases of Flood Problem

For its spring meeting to be held at the Engineers' Club, Dayton, Ohio, April 5-7, the American Society of Civil Engineers has announced the following program on the general subject of "Flood Problems":

April 5, 10 a. m.—Symposium on flood problems: "Flood Conditions in Canada," by J. G. Sullivan, president, Engineering Institute of Canada; "Relation of Federal Government to National Flood Problems," by Major-Gen. Lansing H. Beach, Chief of Engineers, U. S. Army.

April 5, 2 p. m.—"Flood Problems in China," by John R. Freeman, president, Am. Soc. C. E.; "Methods of Flood Prevention in the Mississippi Valley," by J. A. Ockerson, member, Mississippi River Commission; "Relation of Flood Problems to Power and Irrigation Development in the Rocky Mountain States," by A. P. Davis, director, U. S. Reclamation Service; "Flood Prevention Methods on the Pacific Slope," by C. E. Grunsky, vice-president, Am. Soc. C. E., and "Standing Waves in Rivers," by N. C. Grover, chief hydraulic engineer, U. S. Geological Survey Washington, D. C. These papers will be followed by 10-min. discussions led by J. B. Challies, director, Dominion Water Power Branch, Department of the Interior, Ottawa, Canada; Morris Knowles, consulting engineer, Pittsburgh; Harrison P. Eddy, consulting engineer, Boston; George M. Lehman, engineer Department of Internal Affairs for Pennsylvania, Harrisburg, Pa.

April 5, 8:15 p. m.—"Flood Problems of the Miami Valley and Their Solution," papers by Arthur E. Morgan, former chief engineer, and Charles H. Paul, chief engineer, Miami Conservancy District.

For April 5 and 6 excursions to the Miami Conservancy District's works and elsewhere have been arranged. At a smoker April 6 Col. E. A. Deeds will speak on "Human Phases of the Miami Conservancy Project."

New Plan to Pool Freight Cars and Terminals Opposed

Commenting on the plans recently proposed by the National Association of Owners of Railroad Securities for the formation of a central agency to pool the freight cars of the country, Daniel Willard, president of the B. & O. R.R., has told the Interstate Commerce Commission that the desired ends are now effected through the co-operation of that body and the American Railway Association. In his opinion "nothing could be gained by substituting an experimental agency for one well-tried."

Referring to joint use of terminals and other facilities, Mr. Willard filed a statement which showed that of 128 railway systems operating 229,000 miles of line: 107 reported a total of 1,280 passenger stations used jointly, 95 reported a total of 555 yards used jointly, and 64 reported a total of 554 large bridges used jointly. According to Mr. Willard reports also show that 3,179 separate passenger stations are used jointly by two or more railways, that 394 passenger stations are used jointly by 3 or more railways, that 105 are used by four or more, that 54 are used by 5 or more railways, and that 16,251 miles of track are used jointly.

Philadelphia Engineers Hold Joint Meeting on Zoning

Actuated in part by the hostility to restricting the height of buildings in the central business district of Philadelphia, which led the City Council to strike the central district from the ordinance submitted to it last October by the Philadelphia Zoning Commission, the local sections of the American Society of Civil Engineers and the American Society of Mechanical Engineers, with the Engineers' Club of Philadelphia, the local chapter of the American Institute of Architects, and the Real Estate Board held a joint meeting March 6 on "Zoning and Its Relation to City Development." Addresses were made by Lawson Purdy, who was vice-chairman of the New York Zoning Commission, B. A. Haldeman, formerly city planning engineer with the Philadelphia Bureau of Surveys, now engineer of the Pennsylvania Bureau of Municipalities and City Planning at Harrisburg, and M. B. Medary, Jr., a Philadelphia architect who is a member of the Philadelphia Zoning Commission.

Mr. Purdy sketched the origin, development and beneficial effects of zoning in New York City, laying stress upon repelling the invasion of business districts by manufacturing, and upon the damage caused surrounding property by very tall buildings, such as certain realtors in Philadelphia wish to leave unrestricted.

Mr. Haldeman said that perhaps undue emphasis has been put on zoning as a stabilizer and too little on its being a promoter of orderly growth. He urged that public control by zoning should be provided instead of compelling individuals to fight in the courts one encroachment after another, such as public garages in residence districts.

Mr. Medary showed numerous lantern slides to confute assertions that residence and business property values are not being destroyed because of lack of zoning control in Philadelphia.

Commission Acts to Force Better New York Transit Service

A seat for every passenger during the non-rush hours is included in a "standard of service" that has been set up by the New York Transit Commission. Following an investigation of current conditions, Daniel L. Turner, consulting engineer to the commission, reports actual counts of traffic which disclose that during the peak of the rush hours 13,890 passengers have been carried in cars having 4,000 seats, and that standing has been required during 37 per cent of the time, both day and night. Under the new "standard of service" the period of standing loads would be reduced to about 9 per cent of the total time. The commission has called a hearing on the subject for March 15.

This movement toward better service comes as a result of the recently improved financial condition of the rapid transit companies which is considered by the commission to justify its insistence on a higher standard of service than has prevailed hitherto.

Fire Destroys Montreal City Hall

Fire destroyed the city hall of Montreal, Que., on the night of March 3-4. The building was completed in 1878, after designs by H. M. Perreault.

Kansas and New York Governors Debate St. Lawrence Project

A debate between Governor Allen of Kansas and H. H. Merrick of Chicago, on the one hand, and Governor Miller of New York, on the other, with respect to the merits of the proposed St. Lawrence River Ocean-to-Great-Lakes waterway was the principal feature of the seventeenth convention of the National Rivers and Harbors Congress held in Washington March 1 and 2.

Governor Allen and Mr. Merrick, as proponents of the project, demanded the waterway as a much-needed relief to the transportation difficulties of the country and as a matter of commercial justice to the Middle West, and declared that the improvement would pay for itself out of the water power to be developed. Governor Miller disclaimed any inclination on the part of New York to oppose the project, provided it can be shown to be commercially feasible, and pointed out that the report of the International Joint Commission considers only the engineering feasibility of the project. He urged that before decision is made there should be an impartial investigation into the commercial and financial aspects of the enterprise.

Other speakers at the convention were Ambassador Jusserand of France; J. Hampton Moore, mayor of Philadelphia; Theodore Brent and Millard F. Bowen of Buffalo; John F. Ruge of Florida; A. B. Shepherd of Pittsburgh; Major-Gen. Lansing H. Beach, Chief of Engineers, U. S. Army; Julius Henry Cohen of New York Port Authority; Major E. C. Church of New York, and Arthur McGuirk of the New Orleans Levee District Commission.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Spring Society Meeting, Dayton, Ohio, April 5-6; Subject, "Flood Problems."

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 14-16.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Philadelphia, May 15-19.

The New England Water Works Association will hold its regular monthly meeting at the Boston City Club, March 14. The executive committee meeting at 11 a.m. will be followed by a luncheon. Papers on the "Corrosion of the 36-in. Steel Main at Akron, Ohio," and "Investigation of Electrolysis of Steel Force Main at Akron, Ohio," will be read at the afternoon session.

The Pacific Northwest Chapter of the Associated General Contractors of America will hold its annual convention in Portland, Ore., March 10 and 11.

The Vermont Society of Engineers will hold its annual meeting in Burlington, March 10. Standing committees will report as usual. Allen Hazen will

deliver an address on "Water Works" and Judge Moulton will speak on "Some Points of Contract between the Legal and Engineering Professions."

The Western Society of Engineers in conjunction with ten other engineering and technical societies of Chicago, will hold an all-day "mid-winter convocation of engineers" March 22, at which subjects relating to the engineering problems of Chicago will be treated. Some of the subjects to be treated relate to sewage purification, gas and electric utilities, city planning, railroads, urban, water borne and air transportation. The evening session will take the place of the annual mid-winter dinner of the Western Society which for many years has been the greatest engineering event of the year in Chicago. Other meetings scheduled during March are as follows: "Tests of Caissons for Chicago Union Station," by J. D'Esposito, chief engineer, March 6; "Structural Failures," by T. L. Condron, consulting engineer, March 13.

The Indiana Engineering Society held its forty-third annual meeting in Lafayette last month. The following officers were elected for 1922: President, A. A. Potter, dean, engineering schools, Purdue University; vice-president, John L. Elliott, city engineer of Indianapolis.

The Engineer's Society of Western Pennsylvania elected the following officers at its recent annual meeting: President, H. D. Jones; vice-president, Frederick Crabtree; directors, J. C. Hobbs and C. D. Terry.

Personal Notes

H. T. CORY, consulting engineer, U. S. Reclamation Service, has been chosen as the third member of the Board of Review to report on the present and future needs of the water supply system of Denver, Col. Appointment of of the other two members of the board, Dabney H. Maury and H. S. Crocker, was noted in these columns Feb. 16, p. 295.

GEORGE MATTIS has tendered his resignation as city engineer and superintendent of streets of Oakland, Cal., effective March 1. Mr. Mattis was appointed to the office of city engineer in April, 1920.

JAMES A. BROUK, formerly with the Koss Construction Co., Des Moines, Iowa, has been appointed city manager of Pawhuska, Okla.

GEORGE E. JOHNSON, state engineer of Nebraska, secretary of the Board of Public Works, and chairman of the Capitol Commission, has tendered his resignation, effective Jan.. 1923. Mr. Johnson has served the state under three different governors, and now desires to accept a more remunerative position with a commercial company.

R. C. BROWN, field engineer, state highway department, S. C., has been appointed acting state highway engineer, succeeding Charles H. Morefield, resigned.

D. C. FENSTERMAKER has been appointed principal assistant engineer of the Chicago, Milwaukee & St. Paul Ry., with offices at Chicago.

ALMA H. CHAMBERS has resigned as city engineer of Logan, Utah, and FRED W. THOMAS has been appointed to fill the vacancy.

Business Notes

JOSEPH S. WEBSTER, New Haven, Conn., has organized a sales force to be known as Joseph S. Webster & Co. to represent the Kingsford Foundry & Machine Works, Oswego, N. Y., in the the New England states on Kingsford-Webster water-tube boiler sales. Offices will be established in New Haven, Providence and Boston.

JOHN M. MARION, late with Dwight P. Robinson & Co., and GODFREY M. WEINSTEIN, formerly with Westinghouse, Church, Kerr & Co., announce the formation of John M. Marion & Co., general contractors and builders.

EDMUND A. CAHITT, recently district manager in the state of Oklahoma for the Concrete Products Co., has joined the J. B. Klein Iron and Foundry Co., where he will handle reinforcing and fire-proofing materials.

F. X. KERN, for several years with the Philadelphia Bureau of Highways, has become associated with the Headley Good Roads Co., Chicago. During the war Mr. Kern was a lieutenant with the 23rd Engineers, U. S. A.

W. A. ALEXANDER has been appointed district engineer in charge of the Helena, Mont., office of the Portland Cement Association.

Obituary

CAPTAIN HORACE G. H. TARR, a familiar figure in the water-works field for the past 50 years, died at his home in Philadelphia, March 2, aged 78 years. At the time of his death he was manager of R. D. Wood & Co., manufacturers of water-works machinery, Philadelphia, Pa. At the close of the Civil War through which he served with the Tenth Connecticut Volunteers, Capt. Tarr entered the employ of the Brooklyn (N. Y.) Water Department as an inspector of cast-iron pipe. A few years later as receiver, he operated the Tom Gaylord plant at Newport, Ky. Later he joined the Worthington Pump Co. as salesman. From 1900 until his death he was with R. D. Wood Co. designing, selling and supervising the erection of water-works machinery.

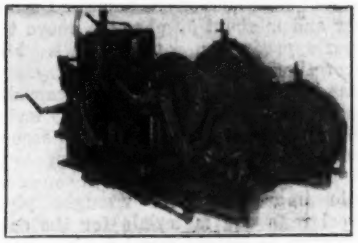
ANDREW MAXWELL, engineer and architect, died in Holland, Man., Feb. 9, aged 77 years. Mr. Maxwell was born in Montreal and was graduated from McGill University in 1865. In 1872 he was engaged by the Government in survey work in connection with the Canadian Pacific Ry. Co. and later was employed by the Hudson Bay Co. in the construction of the first bridge across the Assiniboine River.

ALFRED E. MARTIN, for 20 years superintendent of the Springfield (Mass.) water department, died Feb. 21. He had been superintendent of the water department at Framingham for 17 years prior to his appointment at Springfield. He was engineer in charge of construction of the dam at Ashland for the Boston water-works, now a part of the Metropolitan system. Mr. Martin was formerly president of the New England Water Works Association.

Equipment and Materials

New Gas Engine Hoist

Gas engine hoists ranging from 8 hp. to 110 hp. are now being manufactured by Pawling & Harnischfeger Co., of Milwaukee, Wis. The same hoists are also furnished equipped with

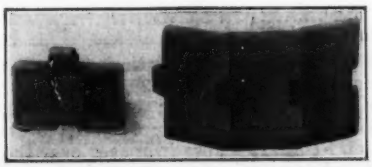


electric motors or for belt drive. On the gasoline hoists the engines are four-cylinder vertical-tractor type, with Bosch magneto, Master carburetors, Stewart vacuum system and air cleaners.

New Paving Mixer With Close-Pitch Crawler Traction

A new full-crawler-traction paving mixer has been placed on the market by the T. L. Smith Co., Milwaukee, Wis. The treads of the new traction are of electric heat-treated steel castings 8 in. wide and with very close-fitting joints. This close pitch of the links excludes more of the dirt and pebbles, which are likely to crowd into the joints and be crushed.

The full-length traction is steered through two all-steel multiple-jaw



clutches. It is furnished on the standard type 14-E and 21-E mixers. It does not wholly replace the half caterpillar and all-wheel types which are quite satisfactory for city or any work where travel is over harder surfaces.

Another feature of these new paving mixers is the new cross-dump bucket, the doors which open crosswise instead of lengthwise. This design, it is stated, discharges more quickly and the concrete can be spread from the bucket as it travels along the boom.

Out-of-the-Ordinary Trade Publications

A well indexed pocket book of 400 pp. for the design and detail of metal lumber joist and stud construction is published by the Berger Manufacturing Co., of Canton, O. For the product to which it relates the book ranks with the well-known structural steel pocket books which have served engineers for years.

Business Side of Construction

Facts and Events that Affect Cost and Volume

Production and Materials Stocks in 13 Cities

Output Increased—Stocks Being Replenished to Meet Spring Building Demands—News from Each City

Steel—The production of steel ingots has reached an annual rate of 29,000,000 gross tons as compared with 22,000,000 gross tons one month ago. This compares very favorably with the output rate of 18,000,000 gross tons for December and is about 50 per cent above the yearly production rate for 1921. Mill operations for the entire industry now stand at about 55 per cent of capacity as against an average of slightly under 50 per cent of capacity for the second week in February. Demand appears to be active in steel sheets, with considerable improvement in wrought pipe. Steel rails and materials for the construction of freight cars have been purchased in large quantities by the railroads. Shapes, plates and bars run mostly to numerous small orders rather than large tonnages. Consumers and jobbers steel stocks and mill stocks of tank plates are comparatively low.

Lumber—An average of 371 mills reporting weekly to the National Lumber Manufacturers Association for the month ending February 25, show a total of 683,385,486 ft. cut; 660,939,476 ft. shipped and orders for 671,747,145 ft. b.m. February shows increases over the preceding month of 39,246,335 ft. in production; 62,490,307 ft. in shipments and 51,841,243 ft. in orders. Both production and shipments for the week ending February 25, stood at about 24 per cent and orders at 25.5 per cent below normal.

Brick—Information as of Feb. 1, 1922, received from the Common Brick Manufacturers' Association of America, shows that throughout the northern-central group of states there has been a demand exceeding that of any winter months in the past three or four years. The weather has been unusually favorable for operating some of the plants but current reports show 58 plants closed. Out of this number all but ten are closed for seasonal reasons or for repairs. The accompanying table shows that the quantity of brick on hand has decreased during the past month while orders on the books have increased slightly.

Chicago—Materials stocks in this center are large and delivery facilities very good. Hollow building tile stocks are large compared with this time last year. Business in hollow tile is reported as having fallen off about 25 per cent during February. Lumber, lime, sand, gravel, brick and crushed stone on hand in large quantities; deliveries in few hours. Demand for structural shapes decreased during last month; stocks above normal and immediate deliveries possible. Sewer pipe stocks below normal.

Philadelphia—Sewer pipe dealers have sufficient stock of the smaller sizes on hand to care for present demand; mill deliveries on the larger sizes are now being made. There are about 15 carloads on hand in the city yards. Local refineries well stocked with asphalt, both for domestic and export trade. Wood blocks and paving stone stocks low. Large orders for wood blocks have been placed but deliveries have not been started. Immediate deliveries on sand, gravel and crushed stone from local pits. Cement stocks normal at present but being gradually increased to meet heavy anticipated demand. Lime stocks of local dealers low, about 5,000 bbl. on hand in warehouses; deliveries within two months. Brick yards have been producing for future business but demand is greater than was expected. About 10 carloads of hollow tile in yards, but stocks will be replenished to greater than normal within a few weeks. Lumber yards well stocked and dealers look for heavy orders within short time.

Denver—About 10 carloads of asphalt on hand, within city. Sewer pipe delivered in 24 hr. from local plant. About 6,000,000 common brick and 10,000 bbl. of cement on hand. Twenty four local lumber yards amply supplied for immediate deliveries.

Atlanta—More than 5 carloads of structural shapes; 10 carloads of lime and 20 carloads of cement on hand at present. Plenty of common brick and lumber. Sewer pipe and hollow tile delivered in 2@3 days.

Los Angeles—Supply of brick, sewer pipe and hollow tile sufficient for all orders. Not on market for paving block, yellow pine or spruce but yards well stocked with Douglas fir and hemlock.

Birmingham—Slag, common brick, sewer pipe and cast-iron pipe manufactured locally; supplies unlimited. Small stocks of cement and track supplies. Deliveries in carload lots from cement mills at Leeds, Ala., can be made in 2 days. Reinforcing bars rolled at Bessemer, Ala. Plenty of hollow tile. Large lumber mills nearby and sand shipped in from southern part of state in 1@3 days. Crushed slag used in place of gravel.

Detroit—Local supply of sewer pipe in yards ample for present needs. Heavy dealers stocks of cement with mills close at hand. Immediate deliveries on any quantity. Quick shipments of lime from Ohio mills; 20 carloads in warehouses at present time. Local brick yards supplying large quantities for immediate delivery. Hollow tile stocks limited with small demand; deliveries slow. Lumber stocks slightly decreased. Average monthly stock about 10,000,000 ft. b.m. Prompt deliveries from southern mills.

Minneapolis—Stocks of brick, lumber and hollow tile limited. Lime and brick supplied by local plants; 24 hr. deliveries. Hollow tile deliveries take from 4 to 5 days. Small cement stocks in local warehouses with unlimited supply available at nearby mills.

San Francisco—Plenty of sewer pipe; deliveries 2@3 days. About 10,000 bbl. of cement in local dealers warehouses with mill shipments in 2@4 days. Lime stocks average about 3,000 bbl. with replenishment in progress. Enough brick; deliveries in 2@7 days. Hollow tile sufficient to meet demands; shipments in 2@3 days. About 30,000,000 ft. of Douglas fir on hand; mill shipments 30 to 45 days.

Cincinnati—About 8,000 ft. of sewer pipe; 12,000 bbl. of cement; 13,000,000 common brick and 100,000,000 ft. b.m.

REPORT ON BRICK FROM 97 YARDS AS OF FEB. 1, 1922

Dist. No.	Including States of	No. of Firms Reporting	Plants Closed Down	Burned Brick on Hand	Orders on Books	Price per Thousand at Brickyard	Price per Thousand at Brickyard Jan. 1, 1922
1.	N. Y., New England	7	6	5,311,000	2,450,000	$14.00 to $17.00	$14.00 to $18.00
2.	Pa., N. J., Md., D. C., Del.	9	3	28,377,000	22,018,000	12.00 to 16.00	12.00 to 17.00
3.	Va., N. C., S. C., Ga., Fla.	10	6	11,060,000	4,615,000	6.00 to 16.00	7.00 to 16.00
4.	Mich., Ohio, W. Va.	10	7	10,320,000	12,404,000	10.00 to 17.00	12.00 to 18.00
5.	Ill., Ind., Wis.	24	7	154,115,000	99,359,000	11.00 to 17.00	11.00 to 17.00
6.	Ky., Tenn., Miss., Ala., Ark. La.	15	13	11,769,000	3,421,000	10.00 to 15.00	9.75 to 15.00
7.	N. and S. Dak., Minn., Neb., Ia., Kan., Mo.	8	8	4,229,000	200,000	11.00 to 17.00	11.00 to 17.00
8.	Okla., Tex., N. M.	7	5	5,388,000	1,287,000	8.00 to 14.00	8.00 to 14.00
9.	Wash., Ore., Mont., Wyo., Ida., Utah., Col.	4	3	1,590,000	381,000	12.00 to 17.00	12.00 to 17.00
10.	Cal., Ariz., Nev.	3	..	5,821,000	5,905,000	14.50 to 15.00	14.50 to 15.00
	Total	97	58	237,980,000	152,040,000		

of lumber on hand in warehouses.

New Orleans—Ample stocks of sewer pipe, lime and hollow tile on hand with no demand. Consumption of cement has fallen from 7,000 to 3,000 sacks weekly; sufficient supply on hand. Plenty of brick available to meet all demands. Lumber supply normal with facilities at hand for replenishment.

Montreal—Plenty of sewer pipe, lime and common brick. Cement stocks ample; not much demand. Lumber and hollow tile deliveries in 24 hr.

New York—Winter reserve of Hudson River common brick all sold out. Brick are being shipped in by rail from northern New York and Connecticut; large quantities also received from Staten Island and the Raritan River District. Cement dealers are preparing for a heavy spring demand; plenty now in reserve. Local lime stocks increased by shipments from south. Large tile factories near the city can ship hollow partition tile in 500-ton cargoes within lighterage limits in short time.

Middle West Cement Situation Summed Up

Mill Price of $1.30 Net Accepted as Fair by Four Highway Departments—Atlas Company Issues Statement

Four states of the Middle West—Wisconsin, Illinois, Indiana and Michigan—went into the market Feb. 28 asking for simultaneous bids on cement to build a large portion of the 1922 program of concrete highways. The quantity required, 4,088,000 bbl. in Illinois, 1,119,000 bbl. in Michigan, 1,468,000 bbl. in Wisconsin and 211,000 bbl. in Indiana, is approximately one-quarter of the rated capacity of the cement mills in the region. While many bids were identical, the Marquette Cement Manufacturing Co. bid on the lowered base price of $1.30 which it had previously made public; it did not bid in Michigan. There were many restrictions and complications in all of the states, the Marquette Company, for instance, restricting the amount it would furnish to 600,000 bbl. in Wisconsin and 600,000 bbl. in Illinois. In Indiana the Louisville Cement Co. put in two bids for several points of delivery, one for steam-rail delivery, which was the same as the Marquette bid, and a lower price for delivery over the electric interurbans. By this means the Marquette and Louisville companies will each get about half the Indiana quota.

In Michigan there are several smaller mills which took advantage of their advantageous nearby location to put in bids lower than the market at the basing-rate points of the larger mills. Practically all of the companies put in limits as to the amounts they would furnish, either as a total or at least for the maximum during any one month. In general, the large companies, aside from Marquette, held to the public quotations in effect at the present time, modified, of course, by the freight differentials from the various basing points.

At a conference Mar. 3, in Chicago, of the executive officers of the highway departments of the four states, it was decided to accept only the bids of the Marquette company and the few others that were equal to or lower than the Marquette bids, which in general were based on a net of $1.30 per barrel at the mill at La Salle. The typewritten sheets given newspapers after the conference included these statements:

"At this conference the bids on portland cement, recently received by the various states, were thoroughly discussed. As a result, it was decided by the states that the bids submitted by the Marquette Cement Manufacturing Co., were fair, and that they represented the present economic conditions. It was further decided that the bids of this company would be accepted. The bids of all other companies which were in excess of the Marquette company's bids were rejected, and further negotiations will be undertaken later.

"At this meeting the prices of all other materials entering into road construction were discussed and it was the opinion of the states represented that united effort should be made to insure that all prices for all materials were fair and in accordance with prevalent economic conditions.

"In order that the various highway departments may be fully conversant with each other's problems and conditions, it was decided to hold such conferences at frequent intervals."

Marquette, by the 1920 directory of cement, gypsum and lime manufacturers compiled by *Cement, Mill & Quarry*, has a rated capacity of 6,000 bbl. per day, making a total for a 300-day year of 1,800,000 bbl. The Illinois and Indiana quota of 600,000 bbl. each will therefore absorb two-thirds of Marquette's capacity as rated in the directory. However, it is understood that the yearly capacity has since been increased to approximately 2,500,000 bbl. At any rate, dealer announcements

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (cement, San Francisco, 10,000 bbl.); time required for delivery of carload lots to city job, example: (sewer pipe, Atlanta, 2 to 3 days); and stocks on hand in general terms, example: (common brick, New Orleans, plenty.)

	New York	Denver	Detroit	Minneapolis	Philadelphia	San Francisco	Cincinnati	New Orleans	Atlanta
Sewer pipe	Ample Prompt deliveries	24 hr. del. local plant	Moderate supply	.....	15 cars	Plenty. Del. 2 to 3 days	8,000 ft.	Ample	Sufficient Del. 2 to 3 days
Cement	70,000 bbl. Plenty in reserve	10,000 bbl.	Large nearby mills	4,000 bbl.	Enough	10,000 bbl. Large mill stock	12,000 bbl.	Sufficient Demand dropped to 3,000 sacks weekly	10 to 20 car
Lime (common)	Moderate stock in city; quick mill shipments	.....	15 to 20 cars Ohio mills	Plenty 24 hr. del.	5,000 bbl. Dealers stocks low. Del. within 2 months from mills	3,000 bbl.	.....	Enough	8 to 10 cars
Lime (hydrated)									
Common brick	Winter supply Hudson River brick sold out	6,000,000	15 to 20 cars Ample local yards	Plenty 4,000,000	Sufficient	Fair Ample. Del. 2 to 7 days	13,000,000	No demand Plenty	Plenty
Hollow tile	Large plants near city; quick shipments by water	.....	Small; del. take several days	Small; del. 4 or 5 days	10 carloads	Sufficient Del. 2 to 3 days	.....	Ample	Enough Del. 2 to 3 days
Lumber	Can complete del. on 300 M.ft. in 9 or 10 days	Ample supply 74 local yards	10,000 M.ft. Prompt del. from Southern mills	44,000 M.ft.	Well stocked	30,000 M.ft. Del. 30 to 45 days	100,000 M.ft.	Normal Replenished from nearby mills	Large Nearby mills
Asphalt	Large refineries short distance from city	10 carloads	.....	.....	Local refineries well stocked	.....	.....	.....	.....

Lockwood Committee Offers Bills to Aid Housing

Several bills were introduced into the New York legislature last week by members of the Lockwood joint legislative committee on housing as possible means of increasing housing facilities. In general the bills propose the extension of the existing emergency rent laws to April 1, 1924, and the law exempting new construction from taxation; the granting of permission to life insurance companies to use 10 per cent of assets in tenement-house construction; and the revision of banking and insurance laws whereby insurance companies and savings-banks would be compelled to invest a fair share of assets in real-estate mortgages. In addition the committee would establish a state trade and commerce commission invested with supervisory powers over trade-associations and trade-unions.

have been sent out by the company stating that its capacity was sufficient to handle its commitments.

In submitting its bid to the Illinois officials the Atlas Portland Cement Co., through its president, John R. Morron, made the following statement:

"With reference to proposals herewith made for the furnishing of cement for state-highway construction, we are most anxious that the position of this company should be understood, both by the officials of the state and by the general public.

"Since our quotations were last made for the furnishing of cement for highway construction it has been asserted by highway officials that the prices asked by cement manufacturers were not in accord with economic conditions and that manufacturers should and must fix prices which will 'be in harmony with the reduced prices now in effect for all other basic commodities.'

"We do not think this criticism of cement is fair or well founded. As shown by government index figures the price asked for cement has been and is now below the average price of other building materials. Cement never reached anywhere near as high a price as was asked for other building materials; consequently, there could not be so great a drop in price as has occurred with respect to other materials.

"The price herewith quoted to the state is 10 to 15c. per bbl. below the price quoted by us last month, 60c. below our market price of January, 1921 and 90c. below the Atlas peak price of 1920. This, it must be admitted, shows a very substantial reduction.

"No decrease in cost of manufacturing our cement has occurred which warrants the reduction in price now made, and unless a wholly unexpected change in costs or market conditions takes place, our company would be unable to continue to accept orders at these figures.

"Our company is, nevertheless, desirous of meeting to the fullest extent within its power the demand for a lower price. It is willing to make some sacrifice to encourage a great public movement, but in taking this step it desires to point out that in our judgment so low a price as now quoted is not justified on a purely business basis.

"The offer herewith is ungrudgingly made as an evidence of a desire to meet the demand for lower prices, and in the hope that this action will in some measure forward the state's highway construction program."

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 97@109, are the following:

A hotel in Chicago, Ill., $15,000,000.

An office building at Philadelphia, Pa., $1,000,000.

A store building at Richmond, Va., $1,000,000.

A bank and office building at High Point, N. C., $1,000,000.

A street improvement project at Clinton, Ia., $350,000.

A road improvement project at Charleston, W. Va., $1,445,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of March 2; the next, on April 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.63	$3.25	$4.00	$2.63	$2.91	$3.50	$3.10	$3.25	—$3.75
Structural rivets, 100 lb	3.50	3.80	5.50	3.43	3.90	4.25	4.50	4.00	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.53	3.15	3.50	2.53	2.81	3.42½	2.75	3.25	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	68%	45%	—59½%	61.9–5%	44%	58.8%	53%	35.10
Cast-iron pipe, 6in. and over, ton	47.30@48.30	37.63	48.30	+42.60@44.10	46.00	52.00	48.00	45.00	—55.00
Concreting Material:									
Cement without bags, bbl	2.30	2.39	2.40	—1.94	2.24	2.90	2.73	2.94	—2.40
Gravel, ¾ in., cu.yd	1.75	1.85	2.00	2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	—1.15	2.00	2.00	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.75@1.85	1.90	2.93	1.60	2.25	3.50	2.25	3.00	—2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	49.00	37.00	34.00	—43.00	38.00	34.75	—29.00	20.00	.....
Lime, finishing, hydrated, ton	15.80@16.80	18.00	25.00	18.00	29.00	24.00	22.00	27.00	—21.00
Lime common, lump, per bbl	2.75@3.48	1.25	2.50	1.40	1.40	2.70	1.75	2.75	11.00
Common brick, delivered, 1,000	—19.40@20.40	—8.25	11.00	11.00	15.00	—12.00	15.50	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	+.07975	.13	.0821	.0752	.08	....	.10	.20
Hollow partition tile 4x12x12, block	.11120	—.06525	.13	.0657	....	.10	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	.87	—.94	.93	+.97	1.01	1.14	1.04	.86	+1.05
Common Labor:									
Common labor, union, hour	.60	.35	.....	.72½	.....	.50@.55	—.56¼	.50@.60	...
Common labor, non-union, hour	.....	.20	.35	.35@.40	.40@.50	.35@.40	.47½@.56	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $2 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump line per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. Lumber price is for No. 1 fir, common.

Seattle quotes on Douglas fir instead of pine. Common lump lime per 180-lb. net.

Montreal quotes sand, stone, gravel and lump lime per ton. Lime and tile are delivered; cement, sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.57 cents). Bag change is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.